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[OFFICIAL NOTICE.]

New England Association of Gas Engineers.

SECRETARY'S OFFICE, BIRMINGHAM, CONN., Jan. 30, 1890.

The Twentieth Annual Meeting of the New England Association of Gas Engineers will be held at Young's Hotel, Boston, on Wednesday and Thursday, Feb. 19th and 20th. The meeting will be called to order by the President, Mr. Robert B. Taber, on the 19th inst., at 10 o'clock A.M. It can now be definitely stated that the following papers will be read sometime during the meeting:

"Vaporization and Feed of Oil to Generator or Retort," by W. R. Addicks, of Boston, Mass.

"Municipal Control of Gas and Electric Light Companies," by Dr. Robt. Amory, of Brookline, Mass.

"Management of Small Gas and Electric Light Plant," by S. J. Fowler, of Westfield, Mass.

"Some Experiments in the Photometer Room," by N. W. Gifford, of New Bedford, Mass.

"A Point or Two in Regard to Illuminants During Condensation and Purification," by George F. Goodno, of Dedham, Mass.

"Notes on Revivification of Oxide," by Waldo A. Learned, of Newton, Mass.

"Various Methods of Introducing Gas Stoves," by H. A. Norton, of Boston, Mass.

"A Few of the Advantages of Water Gas over Coal Gas for Small Works," by F. H. Parker, of Burlington, Vt.

"The Difference between Eastern and Western Methods in the Management of Gas Works," by E. G. Pratt, of Des Moines, Iowa.

"Why I Shall Make Water Gas," by A. B. Slater, of Providence, R. I.

"A Chapter of Don'ts," by W. H. Snow, of Holyoke, Mass.

"Some Notes Taken in a Small Gas Works," by Ralph Woodward, of Waltham, Mass.

"Problems Constantly before the Gas Manager," by E. H. Yorke, of Brockton, Mass.

In addition to the above there are partially promised several other papers. I think all the members who see this notice will agree that, judging by the above list, the coming meeting bids fair to be a greater success than any of the meetings which have been held in previous years. The topics are quite varied, and many of the subjects are among the most important that gas managers have to deal with at the present time.

The officers of the Association believe that no member of the Association, and no one connected with the active business management of any gas company in New England, can afford to be absent from this meeting. Persons eligible for membership and desiring to join the Association will please apply at once to the Secretary, who will forward them blank applications. Although the membership is large, there are still a good many persons connected with the gas business through New England who do not belong to the Association. It is hoped that all such persons will see fit to join at the coming meeting, and make the Association what it ought to be, truly representative of the gas interest in the New England States.

Invitations have been received to visit the Commercial Point and Bay State gas works in Boston, also the Loomis Fuel Gas plant at Waltham, which will add materially to the pleasure of the coming meeting.

CHARLES H. NETTLETON, Secretary.

[Official Notice.]

Ohio Gas Light Association.

Office of Secretary,
Columbus, O., January 20, 1890.

To Members of the Ohio Gas Light Association:

Gentlemen—The Sixth Annual Meeting of this Association will be held at Toledo, O., on March 19 and 20, 1890.

This announcement is made thus early in order that all members may be reminded of the meeting in ample time to make their arrangements to be present. Every member is urged not only to attend this meeting, but also to interest himself in inducing others of his acquaintance who are eligible for membership, but who have not as yet joined the Association, to come to the meeting and become members.

It is not intended that as many papers as usual shall be presented at the forthcoming meeting, in order that more time than formerly may be had for the discussion of those that are read, and for such other matters and business as the members may desire to dwell upon.

Although the Secretary has for some time been engaged in the work of soliciting papers for this meeting, he has not yet secured as many as should be had, notwithstanding fewer are desired than heretofore, and he therefore earnestly calls upon all members who can possibly do so to notify him immediately of their willingness to furnish papers.

It has been decided that an interesting and valuable feature of our meeting would be a "Question Box," in which members can place questions, which will be withdrawn and read to the meeting and answered and discussed by the members. Every member is requested to send to the Secretary at once any question or questions which he would like to have thus brought before the meeting.

Future circulars will announce further details concerning the meeting.

Respectfully, Irvin Butterworth, Sec'y.

BRIEFLY TOLD.

Attempting to Settle the Baltimore (Md.) Gas Question—Readers of the Journal have from time to time been advised of the approach toward a settlement of the matter of regulating gas rates in Baltimore, which settlement is noteworthy from the fact that its plan is based on protection to the Gas Company. The Armstrong measure was somewhat crude and its conditions were such as to antagonize the Gas Company, hence there is slight reason for believing that it will ever become law. As hinted in our last another bill (to which we believe the proprietors of the Consolidated Gas Company are not altogether averse) has been presented to the Legislature, the substance of which is shown in the following lines from a correspondent at Baltimore:

"A gas bill, which it is intended shall be reported from the Committee on Corporations as a substitute for the Armstrong bill, has been handed in. The bill provides that the Consolidated Gas Company shall have the exclusive privilege of manufacturing and furnishing gas for 25 years in the city of Baltimore, at $1.25 per 1,000 cubic feet. In consideration of this privilege the Company is to pay into the city treasury the sum of $10,000 per year. If the Company shall declare a dividend amounting to 3 per cent. a year, then they shall, in addition to the $10,000, pay to the city 3 per cent. upon the 3 per cent. dividend. That is, if a 3 per cent. dividend is declared upon the present $11,000,000 of stock, or $330,000, the city is to get 3 per cent. upon that sum, or $9,900, making, with the $10,000, a total payment to the city of $19,900 per annum. That is the full amount which the bill proposes to give the city, for there is no provision to increase the payment in the event of the Company earning, say, a 6 per cent. dividend. Mr. Colton, in committee, has amended the bill to provide that if at any time the average charges for gas in the cities of Brooklyn, New York, Boston, Jersey City, Philadelphia and Washington shall be less than the price charged in Baltimore, then the Consolidated Company shall sell gas at less than $1.25. Another amendment provides that if at the end of ten years no dividend is declared by the Consolidated Gas Company, then the exclusive feature of the bill shall lapse. It is quite likely that this bill will be endorsed by the Legislature."

Personal.—Mr. H. C. Leonard, of the Portland (Oregon) Gas Light Company, sailed from this port for Europe, per steamship Trave, on the 8th inst. He goes abroad for a pleasure trip.

Mr. Samuel J. Fowler has been appointed to the Superintendency of the Springfield (Mass.) Gas Light Company, vice Mr. J. L. Hallett, resigned. Mr. Fowler has for some time back been Superintendent of the Westfield (Mass.) Company.

Recommending a Change in the Massachusetts Carbonic Oxide Regulations.—The Board of Gas and Electric Light Commissioners (Mass.) have submitted to the Legislature the following draft of a bill proposing to alter the current restrictions in the matter of the percentage of carbonic oxide that may be retained in illuminating gas as distributed in that State—the Commissioners "strongly recommend" the passage of the measure:

"*Section I.*—The Board of Gas and Electric Light Commissioners may, on such terms as it deems prudent, license any gas company now or hereafter authorized to make gas for illuminating purposes to make and sell water gas for such purposes containing any percentage of carbonic oxide that said Board may determine; and may at any time, after notice to a company so licensed, alter or revoke the license.

"*Section II.*—The percentage of carbonic oxide allowed, and the terms and conditions imposed by said Board, shall be stated in the license, a copy of which the Company shall cause to be delivered to each of its customers; and if the Company holding the license does not exceed the limit of carbonic oxide so fixed, nor violate any of the terms and conditions contained in the license, it shall be exempt from any penalty or prohibition provided in section 14 of chapter 61 of the Public Statutes relating to carbonic oxide.

"*Section III.*—Chapter 428 of the Acts of the year 1888 is hereby repealed.

"*Section IV.*—This Act shall take effect upon its passage."

Explosion at the St. Paul (Minn.) Gas Works.—The following letter explains itself:

The St. Paul Gas Light Company,
St. Paul, Minn., Feb. 10, 1890.

To the Editor American Gas Light Journal:

An explosion of gas occurred at 5.50 P.M., Saturday, the 8th inst., in our condenser room, damaging the building to the extent of some $5,000, killing one man and injuring three others. This room is at the end of our retort house, separated by a heavy brick wall, and contains an exhauster, condenser and scrubber. The building and machinery were new, and the structure was well ventilated. The force of the explosion laid low the four walls, completely wrecking this portion of the building; but fortunately the machinery, as well as the benches in the adjoining room, suffered no damage; hence we will be able to repair the building and have the plant in operation in about 8 days. As yet we are unable to give any cause for the accident. Mr. A. D. Cressler and the writer were in this building 40 minutes previous to the explosion, and found everything in perfect working order—Mr. C. declaring our arrangement and machinery the very best. The night foreman was in this room two or three minutes prior to the accident, and declares that the machinery was working all right, with no indication of leakage. As soon as possible we cleared away the debris, in order to get the condition of seals and Huntoon governor, which we found full of water and perfectly sealed, making out the explosion to be still a greater mystery. The portion of our works containing the water gas apparatus was in no way impaired—being entirely separated from the coal gas plant—hence we were able to maintain the regular supply of the city without interruption. Daniel Desmond, the man who lost his life, was an old-time gas man, and well known to many of the gas fraternity. He came to St. Paul with Mr. Kennedy some 30 years ago, and has been in the employ of this Company during the entire period. He assisted Mr. Kennedy in the construction of this plant, and was for many years Superintendent; of late he has had charge of the street department. He was a faithful and conscientious man, and most worthy of the esteem and confidence in which he was held by this Company and all with whom he came in contact. The injured men were employed as stokers in the retort house. Should we discover the source of the accident while overhauling the machinery, etc, shall take pleasure in rendering the Journal a full account of it.

Very respectfully, B. F. Ellison, Genl. Supt.

The Market for Gas Securities.

Consolidated is at 96½, or within a quarter of a point of the price reported in our last. There is nothing of interest to note in connection with the shares, which are being withdrawn from the market every day. Brooklyn shares are steady to strong. We note the following sales at auction: 4,000 Williamsburgh 1st mortgage 6's at 111½; 223 shares Williamsburgh gas, at 121¼; 50 shares Brooklyn gas, at 111½; 25 shares Nassau gas, at 120½; 100 shares Consolidated gas, at 96½; 50 shares Flushing (L. I.) gas, at 161; 500 shares Peoples gas (Brooklyn), at 80. Chicago Trusts are weaker, influenced no doubt by the attempt on the part of the authorities to reduce the gas rate to $1 per 1,000. Laclede common is weak, at 16–18, while Bay State common is inquired for at 24–25. We note a sale of 6 shares of Petersburg (Va.) gas, at 144. The Citizens Gas Light Company (Brooklyn) has named the following Directors: S. E. Howard, John P. Rolfe, E. J. Dennison, J. W. Gordon, John Byrne, S. A. Lathrop and F. S. Smith.

M. Sainte-Claire Deville's Study of Coal Gas.*

Writing in respect to certain conclusions arrived at by him in his connection with the Paris (France) gas works, M. Deville says:

I have found that if gas taken at the exit of the meter at the commencement of the charge, *i. e.*, rich, but not tarry gas, be superheated, it requires a very intense heat applied to a slow stream of gas to produce any perceptible difference between the heated and unheated gas. The difference thus produced consists in the loss of about 12 per cent. of its benzine, and 35 cent. of its other hydrocarbons, absorbable by bromine, accompanied by the deposition of carbon in the porcelain tube, and production of naphthaline and anthracene.

If, instead of superheating the gas after purification from tar, it be heated together with the volatile products formed during the distillation, the results are the same as regards the benzine and rich hydrocarbons, so that all that can be concluded is that benzine resists a high temperature better than other hydrocarbons. This question as to the relative amounts of benzine formed during the successive periods of the distillation, which is of theoretical interest, requires further investigation.

However this may be, we know sufficient to be able to affirm that, among all the hydrocarbons which contribute to the illuminating power, benzine is the only one which exists in considerable amount throughout the whole of the distillation.

Experiments carried out on the laboratory scale show that, speaking generally, a high temperature favors its production.

It remains to be learned whether the proportion of benzine depends on the temperature of the coal at the precise moment of decomposition, or on the temperature to which the volatile products are submitted after their formation, during their passage along the red hot walls of the retort.

Recapitulation and Conclusions.—The two chief subjects treated in this article are:

(*a*) The classification of gas coals according to their elementary composition.

(*b*) A study of the amount of benzine contained in the gas, and on the part played by this hydrocarbon in affecting the illuminating power of the gas.

I. At the experimental works of the Paris Company, during the last twelve years, 1,012 coal tests have been carried out, 36,000 kilos being employed for each test.

Of these 1,012 tests, 898 have been made with coal from 23 sources, that from each source having been tested on the average 39 times.

The average results of this large number of experiments are therefore free from variations due to accidental deviations from the normal character of the coal, and consequently clearly show the influence of the composition of the coal upon the various properties of the gas, which are of interest to the gas manufacturer.

The basis selected for this classification is the amount of oxygen contained in the coal, which is considered to represent the combined water, and thus to be the best indication of the geological age of the coal and of its degree of carbonization.

By dividing the coals tested into five classes of types, containing increasing amounts of oxygen, from 5.5—12 per cent., and by calculating the average results from each type, the following conclusions have been arrived at:

As the coal becomes richer in oxygen, the gas produced by its distillation becomes gradually richer in heavy constituents—carbonic acid, carbonic oxide, marsh gas, and illuminating hydrocarbons, and poorer in pure hydrogen.

Its density and illuminating power both increase. It is also to be observed that the proportion of volatile matter, determined by calcination in a crucible, also increases, even when the amount of combined water is deducted.

The volume of coke remaining in the retorts becomes larger as the percentage of oxygen diminishes. The products of condensation (tar and ammoniacal liquors) increase with the amount of oxygen.

Considering the five types of coal, it is found that type III. comprises the best gas coals, those namely which give a rich gas and yet leave a fair quantity of coke of good quality. Types I. or II. give inferior gas, but much coke.

The remaining classes—IV. and V.—give a rich gas, but their coke is small in quantity and of poor quality.

II. The benzine contained in gas may be estimated by simply weighing the products condensed at — 22°, and adding to the weight thus found per cubic meter (moist at 15°) a constant equal to 23.5 grms.

I have shown:

(1.) That air artificially charged with a known weight of pure benzine deposits the whole of this at — 70°, and that the amount which condenses between — 22° and — 70°, is exactly equal to 23.5 grms. per cubic meter (dry at 0° 1,760 min.); this number agrees with that calculated from Regnault's numbers for the vapor pressure of benzine.

(2) That gas treated in the same manner deposits, whatever be its composition, 247 grms. of liquid between the same temperatures, from every cubic meter measured dry at 0° 1,760 min., which corresponds to 23.5 grms. per cubic meter, moist at 15°.

(3) That the liquid thus deposited consists of almost exactly 23.5 grms. of pure benzine, mixed with a little toluene, xylene, etc.

Applying this method of determination under very varied circumstances, I have arrived at the following conclusions:

(*a*) The average gas of the city of Paris contains 39 — 40 grms. of benzine per cubic meter, composed of:

Pure benzine	77
Other hydrocarbons of the aromatic series	23
	100

From 7 — 8 per cent. of the weight, and from 1 — 1.1 per cent. of the volume of the gas is therefore made up of benzine vapor.

Independently of bezine, the gas contains 4 — 4.5 per cent. by volume of hydrocarbons incondensible at 70°.

The illuminating power of the gas is found to be:

Due to benzine	65
Due to other hydrocarbons	35
	100

(*b*) The various qualities of gas may be classed in two symmetrical groups with—

I. Rich, or comparatively rich, gases.
   - A. Produced from oxygenated coals.
   - B. Obtained by distillation, at a low temperature.
   - C. Evolved during the first stages of distillation.

II. Poor, or comparatively poor, gases.
   - A. Produced from coal poor in oxygen.
   - B. Obtained by distillation at high temperatures.
   - C. Evolved during the last stages of distillation.

(1) The weight of benzine contained in a cubic meter of gas is almost the same in all six varieties.

(2) The benzine obtained from gases of the second group is a little richer in pure benzine, and, consequently, a little poorer in toluene and cumene, etc., than from those of the first group. The difference is small but clearly marked.

(3) Rich gases of the first group at the moment of leaving the retort are at a lower temperature than those of the second group, or, to speak more accurately, the temperature of the coal at the exact moment of decomposition is higher for gases of the second group than for similar ones of the first.

We see, therefore, that rise of temperature appears to have the effect of progressively destroying the hydrocarbons of the olefine and acetylenic series, and also those of the aromatic series, with the exception of benzine; of producing, or, at least, of not destroying benzine; of producing pure hydrogen; and finally, of forming naphthaline, anthracene and graphite.

These results may, therefore, be considered as an industrial confirmation of Berthelot's theories on the subject.

(*c*) As regards illuminating power, benzine plays a secondary part in very rich gases, an important part in gases of average richness, and is almost the sole source of the light given by very poor gases. If the whole quantity of benzine present in a gas be removed by refrigeration to 70°, and the loss of illuminating power thus occasioned divided by the weight condensed (which is almost constant for all gases), it is found that the quotient, which expresses the candle power of one gramme of benzine burnt in 100 liters of gas, is much higher for poor than for rich gases.

The limits actually observed are 0.040 candles and 0,250 candles.

This proves that if gas, itself devoid of illuminating power, be progressively enriched with a hydrocarbon, that the illuminating power of the mixture increases much less rapidly than its richness in illuminating material.

It is necessary to remark that these facts have only been proved by applying to all gases, rich or poor, the photometric method founded on the use of the Bengel burner.

It would be interesting to study the variation of illuminating power when each gas was burned at a burner suited to its composition, as the Bengel burner is adapted to the average Paris gas.

* See JOURNAL, Nov. 4, 1889, p. 633.

A Test of an Otto Gas Engine.

By Edgar Kidwell and Edwin R. Keller.

[An abstract of a test made by the authors for a graduating thesis in the Department of Mechanical Engineering, University of Pennsylvania. The article originally appeared in the *Journal of the Franklin Institute.*]

Methods.—The engine experimented on was a 7-horse power (nominal) Otto type engine. The volume of the cylinder and clearance space was determined by filling with water and found to be 0.439 cubic feet for the total volume, and 0.1796 cubic feet for the clearance space, leaving 0.2594 cubic feet for the volume swept through by the piston each stroke.

The gas used during the test was passed through a large meter, and thence through rubber bags to the cylinder, a portion passing through a second meter, being taken from the same supply for the jet.

The pressure of the gas used was taken by a manometer attached to the supply pipe, and the absolute pressure of the gas was found by adding to this reading that of the standard signal service barometer. The temperature of the gas was taken as that of the room, the meter, bags and pipes being practically entirely within the room. Samples of the gas were taken for analysis. The amount of cooling water used was weighed by allowing it to discharge in a vessel for periods of ten minutes during the test, the water running at practically the same quantity per minute throughout the entire test. The temperature of the water before and after leaving the cylinder jacket was taken by thermometers placed as shown in Fig. 1, which also shows the position of a Brown's pyrometer placed in the exhaust pipe of the engine. The length of pipe between the cylinder and pyrometer was carefully covered with asbestos board, preventing radiation to a great extent.

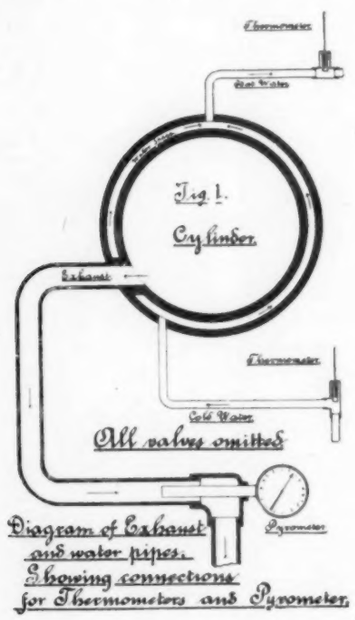


Fig. 1. Diagram of Exhaust and water pipes. Showing connections for Thermometers and Pyrometer.

The power developed in the cylinder during each explosion was determined from a mean indicator card constructed as described below, the power given off by the engine being absorbed by a friction brake on the fly-wheel.

The speed was taken every five minutes by a revolution counter and stop-watch.

It was found necessary to limit the duration of the tests to one hour at a time, because of the heating of the fly-wheel. The engine was started and allowed to run an hour; the brake was then put on, and after the engine had settled down to steady condition the test began. It was continued for an hour, the brake was removed, and the engine kept running until the wheel cooled down, when the brake was replaced and another set of observations made. The total duration of the tests, that is, the actual time during which the observations were made, was three hours, ten minutes.

Apparatus.—The thermometers used were made by Henry J. Green, of New York, and read to degrees Fahrenheit. The pyrometer used was made by Edward Brown, of Philadelphia, and was graduated at intervals of 10° to 1,200° F. The revolution counter used was of the endless screw and wheel type, reading to single revolution. The stop watch read to one-fifth second. The meters used were a large one, made by the Goodwin Meter Company, for gas engine tests, and an ordinary 7-light meter made by the same Company. The scales for weighing the water read to $\frac{1}{100}$-pound.

The apparatus used for analyzing the gas was an Elliott apparatus, similar to that used at the International Electrical Exhibition, in 1884.

A Crosby indicator, with a 100-pound spring, was used throughout the test.

The bulbs of the thermometers used for measuring the temperature of the jacket water were inserted in thin metal cups screwed into the pipe connections, as shown in Fig. 1, the lower one being kept full of water, and the upper one of oil.

The following are some of the results of the test:

Date, Jan. 19, 1889.	
Time of test	3 hrs. 10 m.
Temperature gas	62°.2
Temperature of exhaust	774°.28
Temperature of entering water	50°.43
Temperature of exit water	89°.19
Manometer, inches water	3.06
Barometer (reduced to pounds)	14.85
Total gas used, cubic feet	344.4
Gas for ignition	9.625
Average revolutions per minute	161.6
Explosions missed per minute	6.83

Computation.—As the test was rather for determining the distribution of the head developed by burning the gas, or for getting data for determining its efficiency as a heat engine rather than as a machine, and as the observing force was limited, the brake horse power was not taken.

The indicator cards were worked up in the following way. Fig. 2 is

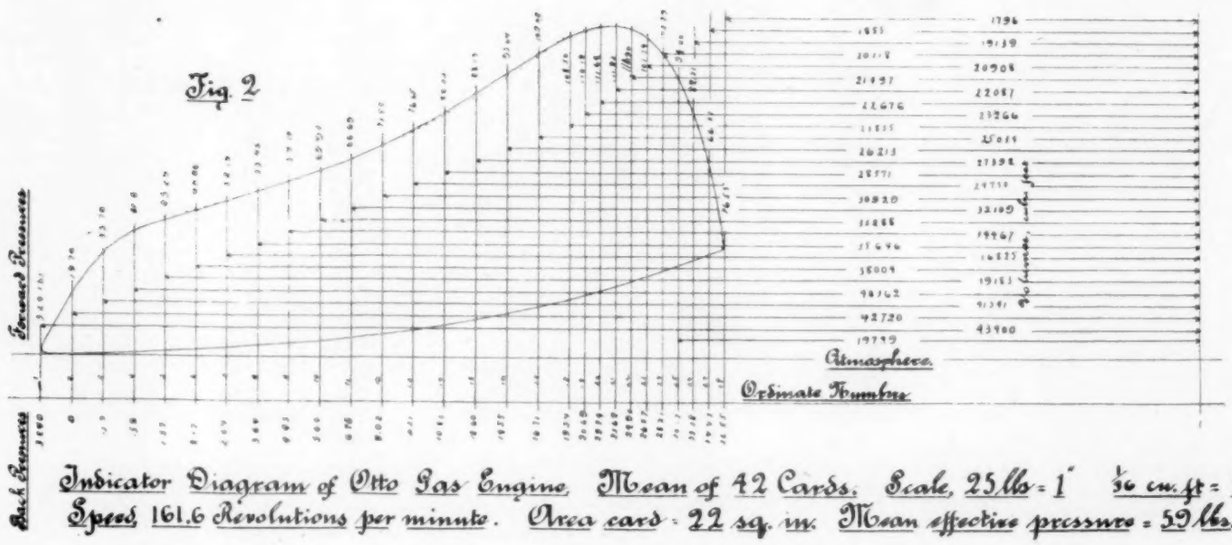


Fig. 2. Indicator Diagram of Otto Gas Engine. Mean of 42 Cards. Scale, 25 lbs = 1" $\frac{1}{50}$ cu. ft = 1" Speed 161.6 Revolutions per minute. Area card = 22 sq. in. Mean effective pressure = 59 lbs.

a mean card obtained as follows: On each of the 42 cards taken 28 lines were drawn at right angles to the atmospheric line as shown, and the pressure of the bottom and top of each card was read and tabulated. From the mean of these tabulated values the card shown in the figure was drawn. From this card the horse power was calculated as follows:

Mean pressure for card = 59 pounds.

Mean pressure per foot = 59 × 144 pounds.

Value of stroke in feet = .2594.

Work per explosion = 59 × 154 × .2594 ft. pounds.

$$\text{Explosion per minute} = \frac{161.6}{2} - 6.83 = 73.97.$$

$$\text{Horse power} = \frac{73.97 \times 59 \times 144 \times .2594}{33{,}000} = 4.939.$$

It will be noticed that the exhaust and admission parts of the diagram are omitted, as they practically coincided with the atmospheric line.

In addition to finding the work done, the mean card was used to determine the general equation of the expansion, compression, and explosion part of the diagram.

In determining these curves the part between ordinates (8) and (28) was taken for the compression curve in the calculation; the explosion curve was taken to embrace all the upper curve between (23) and (28); and the expansion curve was taken to cover all the upper curves between (5) and (18).

The expansion and compression curves were assumed to vary according to a law $p\,v^n = c$, in which p is the pressure in pounds per square inch and v = the volume in cubic feet of the mixture, while c and n are constants. By taking the values of p and v, as given on the mean indicator card by the method of Least Squares, the most probable values of n and c were determined.

The equation to the curve of expansion was found to be

$$p\,v^{1.4385} = 15.901,$$

and for the compression curve was found to be—

$$p\,v^{1.5313} = 3.7557.$$

The explosion curve was found to be practically a parabola, whose equation is—

$$y = -1.788\,x + 32.833 \pm \sqrt{89.423\,x - 1588.61}, \text{ in which}$$

$$y = \frac{p}{10},\ x = 100\,v.$$

The broken lines on Fig. 2 show the curves corresponding to the equation, and the following table gives the errors by calculation:

Expansion Curve.

v	p from Equation.	p from Card.	v	p from Equation.	p f'm C'd
.23855	124.97	123.20	.32109	81.52	81.39
.25034	116.60	117.18	.33288	77.41	77.63
.26213	109.11	110.34	.34467	73.62	73.89
.27392	102.47	103.49	.35646	70.14	70.15
.28571	96.44	97.03	.36825	66.97	66.89
.29750	90.98	91.25	.38004	63.98	63.56
.30929	86.02	86.25	.39183	61.23	59.99

Compression Curve.

v	p from Equation.	p from Card.	v	p from Equation.	p f'm C'd
.17960	52.06	52.25	.25034	31.32	31.41
.18550	49.55	49.13	.26213	29.19	29.25
.19139	47.24	47.08	.27392	27.29	27.30
.19729	45.09	44.87	.28571	25.58	25.53
.20318	43.10	42.91	.29750	24.04	23.91
.20908	41.26	41.27	.30929	22.65	22.72
.21497	39.54	39.60	.32109	21.39	21.46
.22089	37.93	38.32	.33288	20.24	20.34
.22676	36.43	36.94	.34467	19.19	19.15
.23266	35.03	35.39	.35646	18.22	18.34
.23855	33.70	33.94			

Explosion Curve.

v	p from Equation.	p from Card.	v	p from Equation.	p f'm C'd
.1796	48.90	51.25	.19729	108.70	108.70
.1855	80.59	81.01	.20318	116.55	116.99
.19139	97.10	97.01	.20908	121.91	122.49

Heat.

From the mean indicator card it was found that the mean pressure was 59 pounds per square inch, and the work performed per explosion was 59 × 144 × .2594 (volume passed through by the piston) = 2203.8 foot pounds. This is equivalent to—

$$\frac{2203.8}{772} = 2.854$$

heat units transformed into work at each explosion.

From the amount and temperature of the jacket water it was found that 461.92 heat units were carried away per minute by the cooling water. Or, as there were 73.97 explosions per minute—

$$\frac{461.92}{73.97} = 6.24$$

heat units removed per explosion by the cooling water.

The following gives the results of the tests of the gas used as determined by the Elliott apparatus:

	By Volume. Per Cent.	By Weight. Per Cent.
CO_2	.50	1.923
C_2H_4	4.32	10.520
O	1.00	2.797
CO	6.33	15.419
CH_4	27.18	38.042
H	51.57	9.021
N	9.06	22.273

The following are the calculated results from these values:

	Weight per Explosion.	Heat Developed per Explosion	Oxygen Required.	—Products of Combustion.— H_2O.	CO_2.
CO_2	.00001210	.....	.....	.....	.....
C_2H_4	.00013903	1.6785	.00045667	.....	.00001210
O	.00002420	.....	.00002420	.00017852	.00043682
CO	.00011313	.5322	.00006464	.....	.00017776
CH_4	.00027730	6.4927	.00110920	.00062396	.00076260
H	.00006580	3.7364	.00052640	.00059216	.....
N	.00016190	.....	.....	.....	.....
	.00079346	12.4398	.00213271	.00139464	.00138928
Nitrogen			.007101		
Air required			.00923373		
Gas			.00079346		
Total water gas and air entering cylinder per explosion			.01003319		
H_2O					.00139464
N added					.00710110
N					.00016190
					.01005594

The heat carried off in the products of combustion is—

	Heat Units.		Per Cent.
In H_2O (steam)	1.9291		
CO_2	.2149		
N	.2438		
Heat carried off in exhaust	3.4049	$= \frac{3.40}{12.44} =$	27.93
Heat converted into work	2.85	$=$	22.91
Heat taken by jacket water	6.24	$=$	50.16
Total heat accounted for	12.49		100.4
Total heat received	12.44		

These calculations are made on the supposition that the amount of air supplied to the cylinder is just enough to cause complete combustion, and are given for what they are worth. That they are, at least to a certain extent, justifiable can be seen by the following:

.00079346 pounds of gas occupying $\frac{334.78 \text{ (cubic feet, total)}}{14054 \text{ (no. explosion)}}$ cubic feet, at 62.2° F. and a pressure of 14.96 pounds per square inch, requires .00923373 pounds of air to completely burn it.

It is fair to suppose that just before the mixture of gas and air is compressed it has the temperature of the cylinder, which must be about that of the jacket water, or 89.19° F. The gas occupies a volume of

$$\frac{334.78}{14054} \times \frac{548.59}{521.6} \times \frac{14.96}{14.85} = .02523 \text{ cubic feet.}$$

.00923373 pounds of air at 14.85 pounds per square inch and a temperature of 89.19 occupies .22985 cubic feet. The total volume occupied by the gas and air is therefore .25508 cubic feet. The clearance volume was filled with the products of combustion at this same pressure and temperature before the mixture of gas and air was drawn in. The incoming gas and air should therefore fill a volume equal to the stroke displacement, or .2594 cubic feet, and we have therefore a volume of air = .2594 − .25508 = .00432 cubic feet of air drawn in, but not used, a quantity that we can omit in our calculations.

Water Gas for British Gas Works.

By C. J. R. Humphreys.

[Communicated by the author to the London *Journal*.]

I have been very much interested in the article which appeared in the *Journal* for Nov. 19, last year (p. 962), entitled, "Is Water Gas Possible for British Gas Works?" wherein you—very justly, I think—make the point that at this time it is not wise to declare that water gas is inadmissible to British gas works. The article interests me particularly, as I have been using water gas in connection with coal gas at my own works; and on this general question I should like to speak at length. I will, however, reserve what I have to say on the point for another time; and will consider in the present communication that portion of your article in which you deal with inclined retorts in connection with the manufacture of water gas. This is a very interesting phase of the question, because, admittedly, where water gas is to be used as an auxiliary in connection with the manufacture of coal gas, the coke resulting from the manufacture of gas by the regular process is the fuel which should be used in the production of water gas—firstly, because the fuel is right at hand; and, secondly, because it disposes at once of a portion of a residual product which at times is nearly a drug on our hands. Obviously, then, the scheme is to convey the coke from the retorts to the cupolas with the least possible amount of labor; and if the heat which the coke possesses when it leaves the retorts can be retained till it is deposited in the cupolas, there is a very decided gain. I believe that in some gas works in this country—notably the Kansas City (Mo.) works—the coal is conveyed from the retorts (which are horizontal, fired by generator furnaces) to the cupolas in buggies; but clearly more labor is involved in the scheme than would be required if inclined retorts were used, and so disposed that the coke from them would drop readily into the cupolas—or generators, as perhaps they are more commonly called. In fact, it was when the manufacture of fuel gas came under consideration, and the imperative necessity of reducing the labor per 1,000 cubic feet of gas manufactured to the lowest point was apparent, that the advantages of inclined retorts presented themselves. From these investigations there grew the fuel-gas process of Messrs. A. C. Humphreys and Walton Clark, which combines the inclined retorts for the manufacture of coal gas and the generators for the production of water gas.

In the article to which I have already referred, the statement is made that the combination of the inclined retort and the water-gas generator is made use of in more than one fuel-gas process; but, as far as my knowledge goes, it is only used in the Humphreys-Clark process. As I have had an opportunity of making a cursory examination of the experimental plant which has been put up at Jersey City, N. J., to show the working of the process, a short description of the scene may not be without interest; reserving for a future occasion a more extended description of the plant, with an account of the results obtained. Concisely stated, the works consist of two benches of inclined retorts, and a generator in front of each setting adjacent to the lower end of the retorts; and the dampers and valves are so arranged that the "blow" gases from the generators can be passed round the retorts of either or both of the settings, or they can go direct to the stack, or any portion of the waste gases can be lead to the settings, and only the balance allowed to escape through the chimney. In working the plant, the coal (ordinary bituminous gas coal) is conveyed to the upper end of the retorts on an overhead track in buggies with openings in the bottom through which the coal is dumped on to a shoot, which guides the coal into the mouth of the retort. The arrangement of the shoot is somewhat peculiar, and of such a nature that the angle it makes with the mouth of the retort can be quickly changed. By experiment, it has been determined what is the proper angle to employ for different kinds of coal; consequently it is found easy in practice to discharge the coal from the buggies into the retort so that the coal will be spread evenly over the length of the latter, without any danger of running through the retort into the channels connecting the generators and the retorts. The coal is baked in the retorts in the usual time—viz., four hours—during part of which the water gas from the generators is allowed to flow through the retorts; the hydrogen absorbing most of the lighter hydrocarbons which in ordinary distillation pass off as tar. From the retorts the combined gas passes through a hydraulic main, and is drawn by an exhauster through condensers, scrubbers, etc. At the end of the period of distillation the red hot coke is pushed from the retorts into the generator. During this process it is not found necessary to remove the lid, as, by a peculiar plunger device, the coke is readily pushed from the retort. By this means the retort is, in a few seconds emptied of the coke resulting from the carbonization of 250 lbs. of coal. The retorts are heated by the waste heat of the gases which pass off from the generators during the time of "blowing up;" and the interiors of the retorts are heated by the passage through them of the hot water gas made during the run.

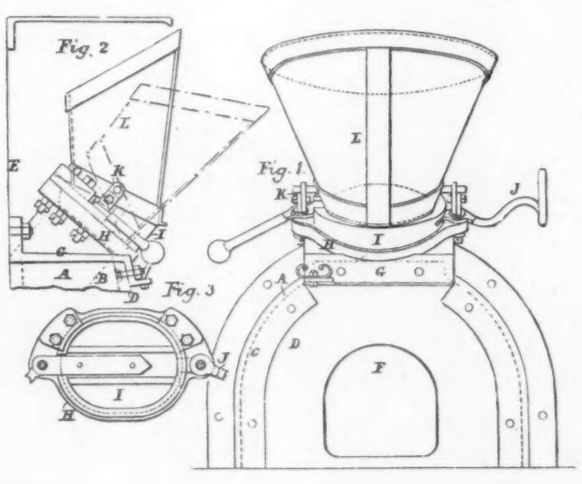
It will thus be seen that the process embodies many economies—the utilization of a portion of the waste or "blow" gases from the generators; the absorption of a portion of the heat of the water gas (which those who have made water gas know to be an item of importance); and the conservation of the heat which the coke possesses as it passes from the retort. Add to this the almost infinitesimal amount of labor involved—the term is not too strong when we remember that all the labor required besides working the valves is the filling of the coal buggies and conveying them to the elevator—and the licking up of the tarry vapor by the water gas in the retorts (for it is found that very little tar is collected in the drips), and we have the promise of a very cheap gas. The resulting gas is, of course, a mixture of coal and water gas of but very low illuminating power, but exceeding in heating effect many of the so-called fuel gases. Add to this scheme an oil carbureter and superheater, and by the use of 2 gallons of Lima crude oil per 1,000 feet, a good illuminating gas could be produced. We thus see the vast possibilities of such a plan—not in the fuel gas field alone, but also, and perhaps to a far greater extent, in that of illuminating gas, unless the future development of the plan brings to light some unforeseen and untoward obstacle.

I hope to be able, in the near future, to take up this matter again, and describe the plant more in detail, and give more information in regard to the nature of the gas produced.

Device for Charging Gas Retort Furnaces with Hot Residual Coke.

Mr. G. R. Hislop, of Paisley, Scotland, has been granted English letters patent (No. 3,391, Feb. 26, 1889) for an invention the object of which is to provide means for directly charging gas producers and gas or shale oil retort furnaces with hot residual coke from the retorts heated by such furnaces, in lieu of transferring the hot coke into buggies and charging the furnaces therefrom.

To that end there is formed a mouthpiece upon a crown plate which is bolted on the top of the projecting brick breastwork of the retort oven and over the ordinary cleaning and charging doors; and therefrom there is formed a shoot extending downwards and rearwards through the upper front wall of the furnace at such an inclination as to discharge the fuel at or near the middle of the furnace. This mouthpiece is furnished with a self-sealing door operated by levers; and it has hinged or jointed to it a hopper which may be raised and held by a



catch close up against the front of the retorts, or lowered and retained (by the same or a separate catch) in such a position that it forms an inclined plane over which and through the mouthpiece the hot residual coke drawn from the retorts is discharged directly into the producer or furnace.

Fig. 1 is a front elevation, and Fig. 2 a side elevation, showing the hopper and part of the front of the retort oven. Fig. 3 is a detailed view of the door covering the shoot leading from the hopper.

The crown of the producer is terminated preferably in an arch of brickwork *A*; and through the top a port or shoot *B* is formed for the

passage of the coke into the producer. The upper or arched portion is bound together by metal jacket plates *C*, securely bolted to the front plate *D* of the producer and the front of the oven *E* respectively. The front plate is furnished with an upper door *F* to facilitate the cleaning of, and a lower one (not shown) for withdrawing the ashes from, the producer. On the top of the jacket plates and over the opening *B* for the passage of the coke, a cast iron crown plate *G*, with doorway *H*, is fixed at a suitable inclination from the face of the oven. The doorway *H* is furnished with ears and stop snugs, and is planed on its face and fitted with a corresponding door or disc *I* hinged on a pin passing through the one ear and held by a jamming lever *J* on the other. The disc *I* at the back passes under pocket plates fixed on snugs to define the travel and fix the position of the disc. On top of the pins passing through the ears and hinging the disc and jamming lever, adjustable journals *K* are formed to receive and carry the axis pin of the charging hopper *L*. The latter is preferably ovular in form and expanded at the mouth to the width of the retort or retorts above. The hopper is preferably placed immediately under the central retorts of the oven; and by casting the hinged oscillating disc *I* sufficiently thick on its lower edge to reduce the angle of inclination, it, when shut, holds the outer edge of the hopper within the line of the retort mouthpieces, and simultaneously with allowing the disc *I* to fall out of position, by reversing the jamming lever *J*, the hopper *L* also falls to the necessary angle to receive the contents of the retorts above it, which are shot into the producer at such an angle as to deposit them in the center of the furnace.

The Walker Gas Washer.

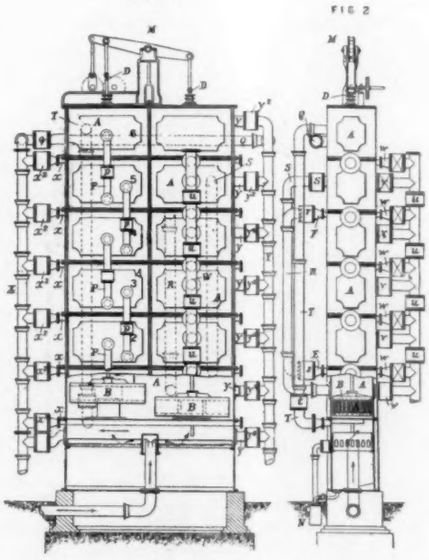
United States letters patent (in supplement of English letters patent, No. 14,925, granted October 17, 1888) No. 420,751 were granted, on the 4th inst., to Mr. William T. Walker, Highgate, England, for certain improvements in apparatus to be used in the purification of coal gas. In his specification, Mr. Walker says:

This invention has reference to apparatus for purifying coal gas—such, for example, as the apparatus described in the specification of letters patent No. 245,527, of August 9, 1881—in which apparatus surfaces are alternately submerged in liquid and raised by a vertical reciprocal dipping movement, so that they when raised present a freshly wetted surface to the gas to be purified, which passes in contact therewith.

Apparatus of this description is very liable to become clogged and inoperative by the accumulation of dense matters; and it is the object of this invention to overcome that objection, to reduce the first cost of the apparatus, and to simplify it and generally render it better adapted for use, as hereinafter described.

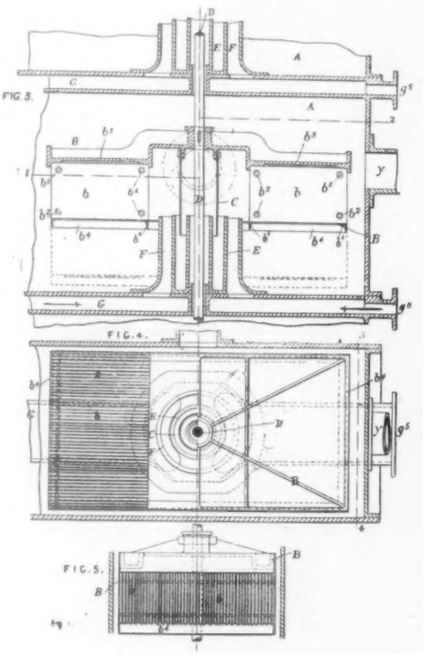
FIG. 1

FIG. 2



Figures 1 and 2 are elevations at right angles to each other (the lower parts being in section) of an apparatus arranged according to the new method. Fig. 3 is an enlarged section of a part of the same. Fig. 4 is a horizontal section on the line 1 2, Fig. 3. Fig. 5 is a vertical section on the line 3 4, Fig. 4.

According to the plan frames *B* are constructed preferably of cast iron, to contain the wetted surfaces, the said frames being open at the bottom and at the sides. They are operated by a reciprocating vertical dipping movement, and the said boxes are at each downward movement entirely submerged, so that the liquid scours and washes the said surfaces, and any thick or dense matter is carried freely off and discharged clear of them. The surfaces contained in the said boxes may be made of any suitable material; but Mr. Walker prefers for the purpose either



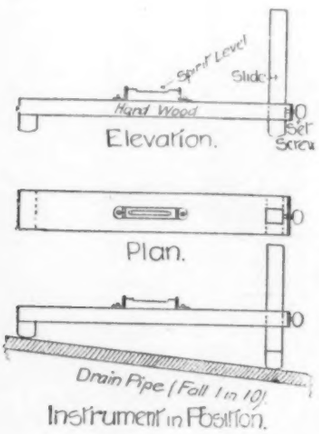
plain iron plates or thin boards of wood, *b*, which may be connected together in groups by bolts, b^3, passing through all the plates or boards. Distance pieces are placed between the plates or boards to keep the proper spaces between them. They are supported at their ends upon the angle bars b^4. The said plates or boards *b* are set vertically and a free-way is left between them to allow the dense or thick matter to be washed freely from them. The said spaces are entirely free and open at the bottom and at the sides, as shown clearly at Fig. 5, and there is also a space between the tops of the said plates or boards and the top of the box *B*, as at b^5 in Fig. 3, to allow of the free passage of the washing liquid. Thus arranged the apparatus is adapted for purifying the gas as it passes from the condensers to the purifiers, and it may be used either in place of or in combination with the ordinary apparatus for purifying gas by oxide of iron or lime. He effects this by isolating the interiors of the superposed tanks *A* from each other by a gas tight seal, consisting of an inverted bell *C*, which is secured to the casting *B*, and that in turn is secured to the operating shaft *D*. The said bell *C* dips into a vessel *E*, secured to the tank and containing liquid, so that the joint is maintained by the liquid as the shaft *D* reciprocates vertically. The gas inlet passage to each tank is, at *F*, external to the said seal and between the opposite sets of wetted surfaces *b b*, and receives the gas to be purified, preferably, from a flat connecting passage *G* beneath each tank *A*, and with a mouth at each side of the machine—one for the attachment of the branch from the inlet main and the other at g^5 for facilitating cleaning. The machine, thus having each of its superposed tanks *A* isolated one from the other, and so constructed as to bring its inlets and outlets to its exterior, can be arranged with a system of connecting pipes and valves, enabling the gas which is to be purified to be brought into communication with any chemical agent, in either or any of the tanks, in any order desired. Thus the gas, after having its tar extracted in the lowermost portion of the machine, may be conducted from No. 1 tank through all the tanks above to No. 6 tank, or either of the tanks may be by-passed; or the gas may be conducted so as to work right round in a circuit. For example, it may be conducted first to tanks Nos. 5 and 6, and thence to tanks Nos. 1, 2, 3 and 4. These connections and valves, as shown in Figs. 1 and 2, are as follows:

X is the general inlet main, having a branch *x* and a valve x^9 to each tank leading into the passage *G*. *Y* is the general outlet main, having a branch *y* and valve y^5 to each tank. *W* is a main for working or by-passing any of the tanks, the said main having inlet branches and valves *w*, outlet branches and valves *v*, and by-pass valves *u* to each

tank. *T* is the return main for conveying the gas from No. 6 tank at the top to No. 1 at the bottom, and *t* is its valve. *S* is a pipe for conveying the gas from No. 5 tank to No. 2, and *s* are its valves. *R* is a pipe for conveying the gas from No. 1 tank to No. 5 tank, and *r* is its valve. *Q* is the general by-pass main for by-passing the whole of the tanks, and *q* is its valve. *P* are the liquor overflow pipes for conveying the purifying liquids from one chamber to another, and *p* are their valves. The gas inlet is shown by the arrows in the lower part of Fig. 1; *N* is the tar well; *M* is the apparatus for reciprocating the boxes *B*.

Device for Testing the Gradients of Pipes.

Mr. J. Leslie Anderson, of Newcastle on-Tyne, England, recommends the use of the simple instrument herewith illustrated as a ready means for testing the gradients of pipes. The inventor has used it with unvarying satisfaction for a term of years.



By simply laying it on its side over a detail of the required gradient the instrument can be at once adjusted, there being no need to mark a scale of gradients on the slide, although that could be done if desired.

The Vagaries of the Electricians.

The *Gas World*, in commenting on certain proposed electric installations in England, remarks:

The vagaries of the electric light are so pronounced that the exhibition of the same undesirable qualities by its professors does not strike the observer as a thing surprising. We are accustomed to hear so many contradictory opinions expressed by the electricians that one more or less does not affect the general result—they are all taken by sensible people *cum grano salis*. We would not for a moment suggest that the many eminent men who have associated themselves with electric science wilfully endeavor to mislead the public; rather would we say that it is a case of the blind leading the blind. In this country we have a body of consulting electrical engineers whose names are honored and respected throughout the length and breadth of the land—they are recognized as men who have attained the highest scientific distinction—but so far as the commercial side of their particular science is concerned they are but as babes. The operations of the practical workers in the realms of electricity have up to now been upon so limited a scale, comparatively speaking, that consulting engineers have not yet had placed at their disposal the data necessary to a uniformity of opinion. They can ascertain the price of a dynamo, the price of a lamp, and the price of a yard of copper wire; but there is very little to guide them to a proper estimate of what these three are capable of when coupled up, or how long they will last. The multiplication of "systems" is another complicating element. The consulting engineer may have some reliable data concerning a continuous-current low-pressure installation; but then his note-book fails him when he wants to compare this with any other kind of installation. The truth is the consulting engineers are groping in the dark, and they have not the courage to confess it. Data is what they require, and, judging from the slow progress the Deptford scheme is making, practical workers are not in a hurry to supply their wants.

We have before us a recent example of what we have indicated above. For an electric light works to supply 10,000 sixteen-candle power lamps in St. Pancras, Prof. H. Robinson, M.Inst.C.E., estimates the cost at £49,731; for an installation of the same size in Brighton, Mr. Shoolbred's estimate is £30,000—practically a difference of £20,000. The systems are different and the localities are different; but each engineer thinks his system the best, and the difference of locality cannot amount to much, seeing that neither estimate includes the cost of a site. Of Mr. Shoolbred's report to the Brighton Council we have little to say, beyond congratulating that gentleman on the bold manner in which he solves the problem which has been puzzling the heads of scientists ever since electricity became known. He says: "It may here be mentioned that the words 'current' and the 'flow' thereof, still popularly used in speaking of electrical matters, are not intended to mean any actual translation of matter. Those words imply more precisely that the molecules forming the conducting wires are thrown, by the exciting magnetism of the dynamo, into a temporary and unstable condition of disturbance, and that this artificial condition is communicated from one molecule to its neighbor, and so throughout the length of the conductor." We cannot say that Mr. Shoolbred's definition is incorrect; we can only remind him that it is not yet generally recognized.

Professor Robinson's report to the St. Pancras Vestry, an abstract of which appeared in our last issue (pp. 100, 101), calls for more detailed notice, inasmuch as, if hurriedly read, if may lead to erroneous conclusions. Professor Robinson deals with both big and little figures. The big ones are comparatively plain, but the little ones must be studied to be understood. Briefly stated, the scheme which he has recommended to the St. Pancras Vestry, and which the Vestry has adopted, is this: A central station to produce current for 10,000 16-candle incandescent lamps; neighborhood of central station to be supplied direct at low pressure; outlying districts to be supplied from five transformer stations worked from the central station by continuous high-pressure current; transformer stations to be also storage stations (with about two hours supply in store!). The cost of erecting the central station and the transformer stations (with the necessary generating plant and storage batteries, and six miles of mains capable of supplying 25,000 lamps) he estimates at £49,731. This does not include the cost of a site for the central station, the Vestry, we believe, having vacant land whereon it can be erected. These works he estimates equal to produce 600,000 watts—530,000 to the incandescent lamps, 20,000 to 40 arc lamps to be used for street lighting, and 100,000 watts of leakage—introducing a point upon which data is much required.

The annual cost of running the installation next engages Professor Robinson's attention. The current supplied to the arc lamps in the streets he charges at 3½d. per unit, and the total cost per lamp per annum (including lamplighter, which is evidently a misnomer) he places at £38 11s. 4d.—£1,542 13s. 4d. for the forty lamps. The two hundred gas lamps which the forty arcs will displace cost only £560 per annum, but then Professor Robinson triumphantly exclaims that the increased cost will result in an increase of 1,300 per cent. in light. If those who put forward this statement could only realize what it means they would abstain from their folly. But at present we are concerned with Professor Robinson's figures, not his fancies. As we have seen, he puts the cost of supplying an arc lamp at £38 11s. 4d. per annum, but to this we have to add the cost of the lamps themselves. "The prime cost of the forty arc lights, if erected in the cheapest possible manner, would be," says the Professor, "£1,000." No provision for renewals, for interest, or for redemption of capital appears to be made. Five per cent. would be a very low estimate to cover the omissions. Add five per cent. to £38 114. 4d., and we get £40 9s. 10d. as the annual cost of an arc lamp—£1,620 for 40 arc lamps, against £560 for 200 gas lamps! If this is the best St. Pancras can do so much the worse for St. Pancras. In most towns in the United States, were gas is so dear, the electric light companies would be ashamed to charge such a price as this.

It is where Professor Robinson deals with the cost of producing the electric current that his report becomes most misleading. For 10,000 lamps he estimate an annual consumption of 800,000 units, and the cost of producing this he puts at 2.80d. per unit. To this, however, he adds 0.75d. for sinking fund (does this include interest?)—making the cost 3.55d. per unit. But if this be correct, it is astonishing that we have not heard of any dividend being declared by those companies who are charging 8d. per unit. To talk about 3½d. per unit when 7d. or 8d. is the usual price may be an alluring bait to the St. Pancras householder at the first glance, but let us see how matters would stand with him were he to get the electric light at Professor Robinson's cost price. For 1,000 hours electric light: 60 units at 3½d. = 17s. 6d. + 3s. 9d. for a lamp = 21s. 3d. For 1,000 hours gas lighting: 5,000 cubic feet of gas at 2s. 6d. per 1,000 = 12s. 6d. + 1d. for burner, 12s. 7d. That is to say, taking Professor Robinson's figures at their best and the figures for gas at their worst, the price of electric lighting would exceed that of gas lighting by close upon 70 per cent. In Brighton, where the Corporation proposes to charge 6d.

per unit, the difference in cost between electric lighting and gas lighting will be about the same. It is to be hoped that the householders of St. Pancras and of Brighton will be made aware of these simple facts before it is too late.

Technical Education.

Engineering, in discussing this subject editorially, remarks that the subject of technical education, like the poor, we have always with us, and for this reason it is apt to be continually shelved till a convenient season, in the press of subjects of more immediate but not greater interest. We are reminded of our duties in this matter by the receipt of several recent publications, which suggest points decidedly deserving of consideration. One of the most important of these particulars is a compilation issued by the National Association for the Promotion of Technical and Secondary Education, entitled "Technical Education in England and Wales." This work is intended to give a brief account of the main objects and working of the chief organizations and institutions which at present exist in England and Wales for promoting and diffusing technical and scientific instruction. A triple classification is attempted, the compilers dividing the matter according to organizations, to grades, and to localities. This has raised an initial difficulty which might well have been avoided; but in spite of it the work is one which may be cordially recommended to all interested in the subject; a term which will naturally include every intelligent employer of labor, and indeed every patriotic individual throughout the kingdom. In saying this we do not wish to support that wholesale demand for technical education, the "vague cry," as Lord Armstrong calls it, which some sciolists appear to think is the panacea for all industrial ills. In fact, much harm has been done by what is termed technical education, wrongly so called if we are to give the term education its true dignity of the acquirement of useful knowledge. In our own profession more especially this danger exists, that we may become too professorial. It is a rock the French educationalists have split upon, and even the practical Germans with their vast system of State-supported education, have failed to avoid it altogether.

Professor Coleman Sellers, of the Stevens Institute of Technology, has recently given in a letter to the United States *Railroad Gazette*, a few instances worth quoting. He mentions some mathematical professors who were fond of discussing equations at once capable of application to the motions of the planets, and of the connecting rod of a steam engine; but they had only developed their knowledge in the former direction, and the transformations needed to reduce it to shape were by no means easy. Even when practical problems are approached by the mathematicians, it is considered, Professor Sellers remarks, rather undignified to make them too practical, and broad generalizations are preferred to direct every-day examples.

Professor Sellers illustrates this by an incident within his own knowledge. Some years ago it was determined by the authorities to make the *Journal of the Franklin Institute* of a less severely scientific but more useful character. A new editor was appointed, and among articles awaiting publication were found some of a highly mathematical character from the pen of a certain learned professor. These were returned to the writer with an intimation that they were hardly of sufficient interest to mechanics at large to be appropriate to the new character of the journal, and asking him to contribute something of a more popular character. The professor took the matter in good part; he said that he had himself been surprised that the journal was willing to publish articles of so purely a theoretical character as he had been writing, but as long as they were willing, he, as a mathematician, was well pleased to work in that line. In place of the mathematical dissertation, he inclosed a valuable practical discussion on the action of jam nuts.

This professor was evidently a man of good nature and good sense, which only emphasizes the moral of the tale; but we will quote Professor Sellers' own words: "The incident well illustrates the tendency on the part of the educated professional instructor to direct his energies along the line of the general and unpractical rather than that of the concrete and useful. And it naturally followed that young men taught under this system, if they came into the workshop, would be distinguished more by ignorance of the concrete methods there called for than by their knowledge, however profound, of the generalities which were not required and which they did not know how to reduce to some useful shape."

This is the danger into which an ill-considered scheme of technical education is likely to lead. There is something about the educational profession that has a narrowing tendency, and it is only the most healthy and practical characters can withstand this. Schoolmasters and professors are always apt to forget that education is a means to an end; and it may be said in passing that the present system on which State education is conducted is calculated to intensify this evil. Fortunately for us at present the chief engineering professors at our technical colleges have not been professors all their lives, but have acquired their scientific knowledge in the course of practical work. Unhappily there are signs that this wholesome state of affairs is not likely to continue, and young men—sometimes very young men—fresh from college, are being appointed to professorial chairs. It is not possible for a teacher to know what scientific attainments will be of the greatest value to the future practical or producing engineer unless the teacher has been himself engaged in practical work. In writing on this subject over 20 years ago, when technical education was seldom heard of, we took occasion to point out the danger of over-refinement of theory. If it were necessary then, how much more so is it now when the professor is so widely abroad.

It may be said that it is the professor's duty to teach only the scientific principles upon which the practical work of the engineer should be founded, leaving the application of these principles to the time when the student shall be launched on his career in life. As a general proposition this is not to be gainsaid. The most perfect academical training cannot take the place of practical work. For educational purposes we had better be without our colleges than our workshops, and that is the reason British engineers still rank before all others, and that in spite of the admirable State-supported systems of technical education of Germany, France and Switzerland. But whilst we acknowledge this limitation to the professor's duties, we must not forget that men, especially young men of the students' age, are not machines, and want some living interest to give them zest for their work. There are few so mentally constituted as to delight in mathematics for their own sake (even the great Bidder invoked the aid of peas), and even these few are little likely to become successful engineers. The purely professional training can hardly fail to relapse into that barbarous system of doing lessons for lesson's sake under which nine out of ten middle-aged persons were brought up.

It is to such reasons that the success of the few private technical schools which we possess in connection with works, such as Armstrong's, the London and North-Western, at Crewe, and Mather and Platt's may be attributed. The latter has been especially successful and is worked on an eminently practical basis. In his evidence before the Royal Commission on Technical Education, Mr. Mather described the system upon which it is carried on. The drawings made are of work actually in progress in the shops. One day the teacher, who is employed in the works himself, gives the necessary calculations, and the next the pupil sees the work carried out practically and commercially in the shops. Mr. Mather told the Commissioners that his firm had derived incalculable advantage from the school. "We desire," he said, "to send out yearly one or two thoroughly competent men who shall not be simply mechanics in the ordinary sense of the word, but shall be able to turn their attention to anything coming under their notice, whether they have done the same thing before or not. We had the greatest difficulty in finding such men until we began to take them from the school; and since the school has been established we have been able to send boys of 20 and 21 to long distances from England, and place in their hands work with which they have not had much to do before."

We have dwelt at length on what appears to us to be the great danger to which technical education is subject. Great Britain has everything to expect from technical education; without it our still unrivalled factories and workshops will not keep us in front of the world's industry. Prof. Coleman Sellers tells another tale, not this time of a professor. The owner of a large machine shop once applied to him for a spur-wheel. He had marked the diameter on a wooden rod. On being asked whether the mark indicated outside diameter or pitch line, he replied: "Pitch line! What the h—— is pitch line? I want a wheel as big as this stick with eighty teeth in it." Now, it will be evident that such men as this, however well equipped for primitive times and rural districts, are not calculated to uphold national engineering industry; but we would rather depend on such a one than on the product of the professors referred to, who could not accommodate the mathematics of the solar system to the movement of crank and connecting rod.

Mr. Reed, of the Wyoming Legislature, has moved for the adoption of a bill providing for the granting of franchises to gas companies by local authorities; said grants, however, not to become operative until they shall have been indorsed by the voters of the cities affected by said grants.

The Possible Average Depth at Which Coal is Now Being Worked in the British Isles.

In a paper read by Mr. Jas. Dickinson, Inspector of Mines, at a meeting of the Manchester Geological Society, the author gives the following opinions respecting this subject

In connection with the question of the progress of the exhaustion of our coal fields there is a point of much interest which could only be successfully dealt with by the co-operation of mining engineers well acquainted with the different districts. I refer to the depth at which coal is being extracted, and the rate at which that average is increasing during successive intervals of (say) 20 or 25 years. With the information now in my possession I cannot pretend to offer more than a very general answer to the question of the average depth, and it is tolerably certain that even between our largest and most important coal fields there may be considerable difference in the average depth of coal produced in each. The question is not to be solved by taking the depths of the deepest and shallowest pits, and taking the mean proportional between them, for we must recollect that the rate of output from shallow pits will generally be very much slower than that from deep pits, as owing to the great primary cost of the latter they can only be made to yield a profit after a large quantity of coal has been raised and disposed of; while, on the other hand, a comparatively small output will suffice to keep a shallow colliery alive. On the above accounts an estimate could be more nearly arrived at by supposing the average depth to be somewhat greater than that between the shallowest and the deepest pits. If we suppose that at the time of the introduction of the steam engine into coal mining in 1820-25, the average depth did not exceed one hundred yards, owing to the necessity of employing horse power for winding and pumping, and if we were to assume the average depth at the present day to be 350–400 yards (probably a near approximation) we should be able to determine the rate of increase of average depth during the last 65 or 70 years. Supposing the rate to have been uniform (which it unquestionably was not) the increase of the average depth would have been at the rate of 4½ yards per annum, or 90 yards in 20 years. But the rate of increase ought to be represented not by a straight line but by a curve corresponding in some degree to that which represents the progressive rate of coal-production from the beginning of the century to the present time. The fact that more than one seam of coal is worked in a coal district somewhat complicates the problem here presented, and for the sake of simplicity it might be stated as "the depth from which the maximum quantity of coal is raised." Now this could be determined if we had before us the depths of all the coal pits or their workings and the output from each particular seam; but this could not be obtained without investigation into details which, proprietors might not wish to have revealed, and which we should have no right to demand. There could be no objection, however, as it seems to me to the disclosure of the depths of all the pits in a coal district and the name of the seam worked; in fact, these details are generally fully known, and if we take these details as a sufficiently close approximation, and make a correction for the cause indicated above, we may come to a tolerably close approximation as regards the average depth. Such details regarding the coal fields of Yorkshire, Derbyshire, and Notts, have been furnished to me by my friend, Mr. J. T. Boot, mining engineer, of Mansfield, and from a comparison of the depths I have obtained the following results, which may not be without interest:

Depth of Collieries in the Counties of York, Derby and Notts.

Yards.	Collieries.	Yards.	Collieries.
Between 0 and 50	* 8	Between 300 and 350	8
Between 50 and 100	*14	Between 350 and 400	2
Between 100 and 150	*31	Between 400 and 450	2
Between 150 and 200	21	Between 450 and 500	5
Between 200 and 250	14	Between 500 and 550	4
Between 250 and 300	10	Between 650 and 700	1

* Some of these are not at work.

Mr. Boot states that in any estimate as to the average depth of mining the shallow pits ought not to be taken into account, some of them not being even at work. If, then, we disregard pits over 100 yards and assume that the output of the deeper pits (say those under 250 yards) is about double that of the shallower (say under 250 yards), we still find that the depth of maximum output will be at a depth of about 250 yards, there being 66 collieries above that line and 32 below, I think 250 yards is in all probability a close approximation for this great coal field, considering that owing to a general low dip of the bed and the occurrence of local flexures (forming synclinal and anticlinal curves) the seams remain at comparatively shallow depths over large areas. As regards the Lancashire and Cheshire coal field, including that of Burnley, I feel satisfied from my own knowledge that the case is different, and that a depth of 250 yards would by no means represent the average for coal production. Perhaps some member of the society would endeavor to work the question out for this district on the principle I have adopted above for the Yorkshire and Derbyshire district, or upon some more reliable data. On the whole, I am of opinion that a depth of 350 to 400 yards would represent more nearly that here under discussion. As regards other coal fields, those of Newcastle, Central Scotland, Staffordshire and South Wales are the most important; and as far as my information extends I am led to believe that a similar depth (that of 250 yards) represents that from which the maximum quantity of coal is now being raised. In conclusion, I would venture to urge on H. M.'s Inspector of Mines, and especially on Mr. Dickinson, the importance of taking up this problem with reference to each of the coal fields under their charge, as by such determinations we shall arrive at a truer knowledge of the exhaustion of our coal fields than by any other method.

ITEMS OF INTEREST FROM VARIOUS LOCALITIES.

Mr. Adam Wallace, Secretary of the La Fayette (Ind.) Gas Light Company, writing under date of the 5th inst., says: "The following may be of interest to you and the gas fraternity. On Monday, Feb. 3d, the stockholders of this Company held their annual meeting and elected the following to serve as Directors: Cyrus Bell, A. Wilson, Wm. Wallace, R. R. Hitt, J. O. Morgan, R. W. Sample and C. H. Peirce; Mr. R. W. Sample succeeding the late Mr. Moses Fowler, who had been President of the Company. Mr. C. H. Peirce took the place held by his father, from January, 1857, until the death of the latter in January last. The Board then elected Wm. Wallace President, and A. Wilson, Treasurer, reappointing myself to the Secretaryship. Mr. Wm. Wallace has held the position of Superintendent for the last 23 years, which position he still retains in connection with the Presidency. The Company contemplates adding a water gas apparatus to be run as an auxiliary to the coal gas plant. While we do no city lighting our sales of gas show a large increase for the year 1889, with excellent prospects for 1890."

At a meeting of the Directors of the Troy (N. Y.) Gas Light Company, held about a fortnight ago, the feasibility of disposing of the Company's property, corner of Hill and Liberty streets and on North Fourth street, was discussed. It was decided to locate the new works of the Company on the site of the Hannibal Green spring factory at the foot of Smith avenue. Secretary Davenport, in confirming this report of the action of the Directors, said: "It is the intention of the Company to dispose of all the property which cannot be profitably employed. We intend to consolidate our gas making plant, in so far as it is possible, under one roof. The holder on Jefferson street will be retained, and it is likely that the holders at Liberty and Hill streets will also not be disposed of. All the other buildings and land at the latter place will be parted with, and so will the uptown works at North Fourth street. Many advantages will accrue to the Company under the new scheme. We will have our own dock for the reception of coal, which heretofore we have been compelled to cart at a great expense. We can also take our water direct from the river, which will be a decided advantage over the driven well system." From this it will be seen that Supt. Henry C. Shields has a busy season before him.

Early this month President Odiorne, of the Gloucester (Mass.) Gas Light Company, appeared before the local committee on Mercantile Affairs to oppose the petition of Geo. Moore and others, who propose to incorporate the Union Electric Light and Power Company. He urged that the field for the supply of artificial light was so restricted that two companies could not possibly survive with profit to the shareholders. He would not, however, oppose the furnishing of electricity by the petitioners for power purposes. The Committee reserved its decision, but in all probability the matter will eventually come before the Board of Gas and Electric Light Commissioners.

The ordinance to grant the Toraya Gas Company the use of the Manayunk station of the Philadelphia City gas works for a protracted trial of its system of wood gas manufacture has been voted on adversely by the Philadelphia Select Council. The vote was 26 against to 1 in favor.

It is reported that Messrs. Lord & McCabe have brought suit against the New Orleans Gas Light Company, alleging that defendant has infringed certain patent rights vested in plaintiff. In its answer defendant pleads that it had constructed, used and operated an apparatus for

manufacturing illuminating gas from petroleum long prior to the issuance of the letters patent to plaintiffs herein to wit (since April, 1873), and which apparatus it uses and was using at the time of the institution of this suit. That the essential idea and feature of the said apparatus as used by the defendant consists of a system of double retorts, or a retort within a retort, used for the purpose of vaporizing petroleum, and this combination of retorts was no novelty at the time of the issuance of the letters patent referred to in plaintiff's petition, but were well known to science and in practical use in the manufacture of gas throughout this country and Europe—notably by the Springfield (Mass.) Gas Company, the Boston (Mass.) Gas Company, the Metropolitan (N. Y.) Gas Company, the Laclede (St. Louis) Gas Company, the Cleveland (Ohio) Gas Company, and by many others. Again, defendant specially denies that it has in any way infringed upon the patent rights asserted by plaintiffs, or that it has in any manner used the ideas or combination claimed as essential novelties in said patent. The case is before Judge Edward C. Billings, in the United States Circuit Court for the district.

In completion of our former mention that one H. Bostwick had prayed for the appointment of a receiver for the Hastings (Neb.) Gas Light Company, we might add that the impelling cause for this action is to be found in the fact that Bostwick claims the sum of $3,000 "for services rendered in soliciting patronage for the Gas Light Company, and for other services done and performed for the Company since January 1st, 1886." The peculiar interest attaching to Mr. Bostwick's "modest claim"—it really amounts to asking $1,500 per annum for two years' services—will be readily appreciated from the following analysis that comes to us from a Hastings correspondent: "When this case is properly indexed it ought to read 'Harrison Bostwick vs. Harrison Bostwick,' instead of 'Harrison Bostwick vs. The Hastings Gas Light Company,' for he virtually sues himself. When Mr. Bostwick (some 4 years ago) was seen going from house to house soliciting patronage for the Gas Company, the people presumed that he was so engaged because of his desire (so loudly and frequently proclaimed) to forward the interests of an enterprise that promised to be of great local value; and Mr. Bostwick was given great praise for his public spirit. Now, however, he claims that the Gas Company, estimating at its true value his ability to wield important political and personal influence, employed him to obtain patronage and secure consumers for it, and alleges that because he is now performing like service for a rival Company, his old employers refuse to pay for what he did for them. The old Company replies that it never employed him, hence it owes him nothing. The trial of this case and its results are of vital interest to many people in this city. Should the issue go to the Supreme Court, there to be decided that the man who has given encouragement to home enterprises is entitled to recover the sum of $1,500 per annum for his services, there will be no end to the litigation that would surely follow. If that rule would hold good, I make bold to say that our local paper, for instance, could collect a sum sufficient to pay for the construction of a building that would put in the shade the famed Equitable Building of New York city. Again, if Mr. Bostwick recovers the amount for which he sues, it will not be safe for any party to make an investment here until the assurance is given that no 'influential' and 'patriotic' citizen has signed an agreement that he will either solicit patronage for or give encouragement to the proposed enterprise."

The Pennsylvania Gas Company (natural gas) has issued a notice to the effect that no new patrons can be served from the Jamestown (N.Y.) lines, as the capacity of the same is unequal to any further drain.

The Columbia (Pa.) Gas Company has chosen the following officers: President, James A. Myers; Secretary and Treasurer, J. C. Clarke; Superintendent, Wm. B. Faesig.

The Philadelphia Councils Committee on Gas Works, at a meeting held early this month, have authorized Director Wagner to place 1,000 gas and 1,000 gasoline lamps in the county precincts during the year.

Certain speculators who are attempting to secure a franchise for the operation of a fuel gas plant in St. Louis, propose to work under the Brazelle process. In support of their scheme they alleged that this process was in successful operation at the works of the Paris (Ills.) Gas Light and Coke Company. The President of that Company, when interviewed on the measure of success that had been gained in its operation of the Brazelle system, said: "The Brazelle process was installed at the works, having been operated experimentally for eight months, and then the gas was supplied to the city for about three months longer. The system is not even a partial success. The history of our connection with the Brazelle process is as follows: A small experimental apparatus had been erected, and the results from it appeared so promising that we determined to discontinue the manufacture of illuminating coal gas and distribute this fuel gas instead, relying upon an incandescent burner to give it luminosity. We were speedily obliged to give the plan up, as it was too expensive and uncertain. Then we attempted to carburet the gas by the addition of oil in the generator, but the attempt was a failure, for the added oil was partly burned out in passing with the gas down through the fuel, and partly deposited by the other extreme of temperature in the fire brick chamber which followed. After 'blowing up,' when the operation of gas making was going on, an explosion would frequently occur, of sufficient force to throw open the lids of the generators, or to loosen the fire brick linings in the same. A very stubborn clinker was formed by the downdraft; the coal used in the process was the same as that which gave us 8,000 cubic feet of good illuminating gas, when carbonized in retorts under the old process; but though Mr. Brazelle claimed to be able to obtain 60,000 feet per ton, he never did make over 11,000 feet, and often not more than 9,000 feet, and this a gas of no illuminating power whatever, and of far less heating value than the coal gas formerly made. Of course, with his process, we saved no tar nor coke, and the gas was consequently far more expensive than coal gas. Dr. Brazelle's method of estimating the yield per unit of coal was also rather peculiar. He first weighed the coal, then after the material had been burned, weighed the remaining ash, and charged the *difference* in weights as the amount of coal used. Even by this figuring he was unable to *make* over 11,000 cubic feet per ton. As a result of this change the only people in Paris who seemed satisfied with the Brazelle gas were the dentists, who found it to answer nicely in fusing their gold. For steam raising and the more extended uses of fuel it would not do at all. The consequence was that when, in January, 1890, the process was finally rejected, the Gas Company had to begin all over again, at a disadvantage much greater than that attending the operation of a new company; for not only had our former customers turned to the use of oil or electricity, but popular sentiment was very strong against us for the loss of the hitherto reliable heating and illuminating agent. After the rejection of this process we returned to making coal gas until a water gas plant of the Pratt & Ryan type was installed, and as this latter has been giving good satisfaction ever since, operated by the same workmen who attended the Brazelle apparatus, no claim of incompetent handling can be alleged in respect to the system that failed so much of Brazelle's 'success' at Paris, etc."

One of the substantial institutions of Clinton, Iowa, is to be found in the works and businesss of the Clinton Gas Light Company, which was incorporated 21 years ago, and which has since been in control of local capitalists. It is capitalized in $65,000. About 300 consumers are on its rolls, the main mileage is 10; there are 75 public lamps, and the output last year was 6,119,000 cubic feet. Mr. Oliver Messer is Superintendent. The Company's business increases constantly, and it enjoys the confidence of the public.

At the annual election of the Peoples (Jersey City, N. J.) Gas Light Company, the following Directors were chosen: F. Morris Perot, Thos. M. Williams, Thos. M. Gopsill, M. A. Cowisen, M. T. Newbold, Frank Stevens, Wm. Muirhead, Jas. L. Ogden and Geo. W. Conklin. The Directors subsequently indorsed the following executive management: President, F. Morris Perot; Vice-President, Thos. M. Gopsill; Secretary and Treasurer, E. N. Case.

At the annnal meeting of the Stockholders of the Easton (Pa.) Gas and Electric Light Company, the following Directors were chosen: General R. Thomas, M. M. Dawson, R. B. Dison, W. H. Thompson, T. Tunis, W. E. Shanahan, Col. O. Tilghman, Jas. H. Covington, C. T. Wrightson and Jas. H. McNeal.

The gas supply of Dalton (Ga.) is giving great satisfaction to the residents.

The Directors of the San Francisco Gas Company have re elected the following officers: President and Engineer, J. B. Crockett; Vice-President, Adam Grant; Secretary and Treasurer, W. G. Barrett.

The Galesburg (Ills.) Gas Light and Coke Company's proprietors having decided to change their method of manufacture from coal to water

gas, have contracted with the National Gas Light and Fuel Company for a Springer apparatus having a capacity of 120,000 cubic feet per diem.

THE following figures and facts are taken from advance sheets of the annual report of Mr. Charles W. Hinman, Massachusetts State Inspector of Gas and Meters. During the past year 13,592 gas meters were inspected, of which number 13,412 were either new or recently-repaired instruments, 180 meters which had been in use some time, and which were suspected to be incorrect either by the consumer or the companies, were brought in for re inspection: of these 42 were found to be too fast, the average error being 5.65 per cent.; 121 were found to be within the legal limits—2 per cent.—16 were found to be too slow, with average error of 15.41 per cent.; and one meter did not register at all. The average error of meters that registered was 0.05 per cent. too slow. All the consumers' meters at present in use in the State are dry, and there is a gradual increase from year to year in the proportion of correct meters to the whole number complained of. The gas made by the various companies in the State has been inspected in the usual manner. Numerous analyses has shown that coal gas, as manufactured in Massachusetts, never contains as much as the legal limit of 10 per cent. of carbonic oxide. Comparing the results with those of last year, there is on the average found to be a slight falling off in the candle power of the gas of the larger companies. This decrease amounts to 0.11 of a candle power. The gas of two of the companies shows a decrease of about 1 candle each; but the lowest average among the larger companies is 2 candles above the legal standard of 15 candles. None of the other changes in the gas of these companies exceed about one-half of candle. The fluctuations in these candle powers have been more pronounced than last year; but the largest fluctuations have been at those places where a mixture of petroleum gas and water gas is used as an auxiliary to coal gas. It is desirable to keep the gas uniformly at one standard, as each grade of gas requires a different burner, or a new adjustment to produce the best result. The gas of the smaller companies has almost exactly the same average candle power as for the previous year, but there are a few considerable variations from the results of the previous years.

THE following terse letter explains itself:

"PORT HOPE (ONT.) GAS COMPANY, Feb. 10, 1890.

"To the Editor AMERICAN GAS LIGHT JOURNAL:—If a gas manager who has had experience in operating an electric light plant of, say, 50 arcs, and another who has about the same service in incandescent lamps, would, through your columns, give to their brother managers the benefit of that experience as to cost of installation, operating expenses and receipts, they would do a good service to their brethren now beset by electric light plant sellers whose statements are to be accepted with a grain of salt. J. SMART, President."

THE following officers have been chosen to manage the affairs of the New Britain (Conn.) Gas Light Company: President, G. M. Landers; Secretary and Treasurer, A. P. Collins; Superintendent, E. C. Learned; Directors, Geo. M. Landers, Wm. Bingham, L. F. Judd, Jas. H. Eddy and A. J. Sloper.

AT the annual meeting of the Independence (Mo.) Gas and Coke Company the following Directors were chosen: C. C. Chiles, L. P. Williamson, W. H. Waggoner, D. Bullard. W. M. McCoy, H. C. St. Clair, J. P. Alexander, R. D. Wirt and J. McCoy.

MR. J. E. MAYO, recently in charge of the Saratoga (N. Y.) Gas and Electric Light plants, has taken service with the Rockford (Ills.) Company.

THE property and franchise of the Corsicana (Tex.) Gas Light Company were disposed of at auction sale on the 4th inst. Messrs. Simkins & Niblett, local attorneys, representing a majority of the bonds, purchased the property. The Company will be reorganized. Our information is to the effect that this sale—the property had been in the hands of a receiver since last August—was brought about on account of legal complications involving the title to the property. We understand that the Company's business has been sufficient to yield a fair profit.

THE bill reducing the price of gas in St. Louis to 90 cents per 1,000 cu. ft. has passed both branches of the municipal legislature, and the posted division claim that Mayor Noonan will sign the ordinance. In the meantime, however, it is of record that the Mayor believes the adoption by the Laclede Company of the old St. Louis Company's amended or substitute charter will prevent the city from carrying out the proposed attempt to regulate gas rates, at least for a term of years. It looks as though the matter will have to go through a very wearisome tangle of law ere the question is finally decided.

THE authorities of Cleveland, O., have been investigating the matter of public electric lighting, and a portion of the investigation consisted of the obtaining of figures from the authorities of other cities as to the rates paid for lighting the lamps in those cities. A compilation of the answers so far received is appended: New Orleans has 934 arc lights of 2,000-candle power, burning every night and all night. Of this number 634, in the city proper, cost $125 a year; 262 suburban, $146; 38 across the Mississippi, $205. The city operates under a 5-year contract. For every lamp not lighted a pro rata reduction, with 10 per cent. added, is made from the monthly bills. The police report lamps not lighted. The entire city is lighted by electricity. Gas lamps per post before electricity was adopted were $16. Cost of gas for city buildings is 1 cent per burner per hour. Fort Wayne, Ind., runs its lights on the Philadelphia or moon schedule, or all night, if the chief of police or chairman of the fire committee orders it. The lights are 2,000-candle power, and cost $135 a year, with a reduction of 5½ cents an hour per light for any lights reported out by the police. Memphis burns 100 arc lights of 2,000-candle power, all night and every night, for $187.50 a year. It pays $20 a year for gas lamps, the same as Kansas City. Denver uses 1,100 20-candle power incandescent street lamps, which cost $26 a year. For 2,000-candle power arc lights, all night and every night, it pays $240 a year. For lamps burned on the moonlight schedule the cost is $150 a year. No gas or gasoline lamps are used. At St. Paul only 54 arc lights are used. They burn until midnight at 35 cents a night. It pays $2.46 a month for gas lamps, and has been paying $25 a year for gasoline, but recent bids sent the gasoline prices down to $16.80 a year. Omaha has just entered into a contract with the Thomson-Houston Company for lighting the city with 100 arc lights for 5 years at $175 a year. The lamps are 2,000-candle power, to burn all night, and the electric light company to make all repairs. It has also made a 5-year contract for gas lamps to burn 5 feet of gas an hour, producing a 16 candle power light for $25 a year. Gasoline lamps are $19 a year. The Brush system is in use in Detroit, which city contains about the same area as Kansas City. It makes contracts for only a year at a time for lights, and has about six hundred 2,000-candle power lights, which cost $140 a year to burn every night and all night. Buffalo has 1,223 arc lights, which cost 42½ cents per night for all night and every night. This is $155.61½ a year. There are three systems used by the city, and the lights are lighted and extinguished by a printed schedule for each month. The city has 4,390 gas lamps burning 4 feet an hour, which cost $17 each a year. The city of Milwaukee uses 270 arc lights of 2,000 candle power, burning each night and every night, for which it pays $150 a year for each. Gas lamps cost $24.70 a year, and gasoline, $20. Quincy, Ills., goes by the moon schedule. It has one hundred and eighty-one 2,000-candle power arc lights burning when the moon does not shine, which cost $100 a year each. It uses no gas or gasoline. St. Joseph has just completed an electric light plant and starts out with 210 arc lights, to cost $6 a month, or $70 a year—$3 a year cheaper than St. Louis. The lamps are 2,000-candle power and burn all night and every night. Gas lamps cost $15 a year, and gasoline, $17. Pittsburg uses 300 arc lamps of 2,000-candle power, burning all night and every night, and pays $105 a year. It also has 1,000 twenty-five-candle power incandescent street lights, which cost $16 a year each. Gas lamps cost the same. In Kansas City, Kas., 96 arc lights of 2,000-candle power are furnished all night and every night at $144 a year. The St. Louis contract is for 1,600 arc lights of 2,000-candle power, to burn all night and every night, at $78 per year; 800 incandescent lights, of 30 candle power, at $17.50 a year, and 800 of the same at $20 a year.

MR. ROBERT J. DOBSON, who has been for the last 20 years connected with the Seneca Falls (N. Y.) Gas Light Company, under the late Wm. Parrish, has been appointed Superintendent and General Manager of the Company.

CURRENT rumor has it that the New Bedford (Mass.) Gas and Electric Light Company has absorbed the local Edison Electric Illuminating Company. It is understood that the basis of consolidation is 10 shares of the latter stock for 8½ shares of the former. This places the light supply of New Bedford entirely in the control of Mr. Taber's Company.

THE Louisville (Ky.) Gas Company is figuring in the local Law and Equity Court as defendant in a suit for damages (assessed at $20,000) brought by a former employee—Peter M. Gillem. Plaintiff was employed as an ordinary laborer, and, on June 26, 1889, while moving a wheelbarrow loaded with brick, was injured through the toppling of a set scaffold. Gillem charges faulty construction.

THE Proviso (Ills.) Light and Water Company has been incorporated by Messrs. H. E. Broughton, Henry Struble and G. L. Thacher. It is capitalized in $15,000. This place is a post township of Cook county, Ills., and is about 11 miles west of Chicago. Population about 6,500.

THE Gas Committee of the Kansas City (Mo.) lower branch of the local government recently held a session, at which certain matters affecting the Gas Company were discussed. Col. M. J. Payne, President of the Kansas City Company, spoke against the passage of the pending ordinance granting to an opposition gas company the right to lay pipes for the supplying of natural and manufactured gas for fuel purposes. Colonel Payne convinced the committee that his Company had been granted by the State Legislature an exclusive franchise for supplying the city and its inhabitants with gas of whatever sort. He also stated that the Company had expended nearly $140,000 in constructing works for the purpose of supplying the city with fuel gas. "We have built a reservoir in the East bottoms," said Mr. Payne, "that will hold 1,000,000 cubic feet of gas. We have laid a 24-inch main from the city proper to it, which main is double the capacity of that which is now supplying the city with illuminating gas. We propose to base the cost of this fuel gas upon the price of a ton of coal, say at $4 per ton." It was shown that Colonel Payne's Company had an exclusive franchise, and the committee therefore returned an adverse report upon the ordinance granting to George Sheidley and others the right to lay mains for supplying the city with natural and manufactured gas.

FOR its alkaline and vivid "cheekiness" the following action, taken last week by "District Assembly 41, Knights of Labor," of Baltimore, Md., will be appreciated. The "Knights," in debate on the bill now before the Maryland Legislature, under which it is proposed to regulate the gas supply of Baltimore, resolved, that while they considered it to the best interest of the community that the city should own its own gas plant, yet they recognized the great danger of placing any greater power in the hands of the municipal government until there has been secured the Australian system of voting and other necessary measures for the proper administration of public affairs. The resolutions stated that it is useless to ask for more than they could reasonably expect to secure. They claimed that as it appeared the Gas Company could make gas at 60 cents per 1,000 and pay interest on $6,000,000 in bonds, therefore the Legislature ought to be called on to reduce the cost of gas 50 cents per 1,000 feet.

THE Dayton (Ky.) City Council is considering an ordinance under which it is proposed to grant to the Bellevue Gas and Light Company an exclusive charter, to last for 25 years.

On the Most Economical Engine for Small Power.

Professor J. E. Denton, in the last issue of the *Stevens' Indicator*, writing on the above-named subject, says:

A certain machine shop possesses two steam engines, one a plain slide-valve throttling 5½-inch bore by 7-inch stroke, the other an automatic cut-off, 7-inch bore by 14-inch stroke, both non-condensing. The shop required 7-horse power to run it, exclusive of the power to overcome the friction of the engine. The question arose whether it was cheaper to run the shop at 70 pounds boiler pressure with the plain slide-valve engine cutting off at three quarters, or with the 7-inch by 14-inch engine cutting off at one-fifth under the automatic action of its governor, or whether fuel would be saved by operating the engines on the compound principle, using the small engine as the high pressure cylinder and exhausting from it into the larger engine through a receiver, the system still being non-condensing. Both engines were carefully overhauled and made perfectly tight at their valve seats and pistons.

Each engine was then tested to determine the power absorbed to run itself, with the result that the small engine absorbed $\frac{6}{10}$-horse power, and the large engine 2½ horse power. The small engine was then made to perform 7¾ indicated horse power at 70 pounds boiler pressure and 146 revolutions per minute, the exhaust escaping into the atmosphere at a back pressure of 17 pounds. The steam consumption per hour per horse power was 45 pounds.

The large automatic engine was then made to perform about the same indicated horse power at the same steam pressure and revolutions, the cut-off being about one-fifth. The steam consumption per hour per horse power was 35 pounds.

The same work was then performed by operating the engine on the compound system at the same boiler pressure and same cut-off in the small engine, and with 26 pounds receiver pressure and about one-half cut-off in the larger engine, the exhaust passing into the atmosphere from the larger cylinder. The ratio of the cylinders made the ratio of expansion 4½, including clearances, or practically the same as the real ratio of expansion when the large engine was used alone, the clearance of the latter being 5 per cent. The steam consumption per hour per horse power was 33 pounds.

It follows from these results, that to obtain the 7 net horse power required to operate the shop, the indicated horse power for the three methods would be as follows:

System.	Friction.	Net Work.	Total or Indicated H.P.
Small engine	0.6	7	7.6
Large engine	2.5	7	9.5
Compound engine	3.1	7	10.1

The expense measured in steam consumed per hour will therefore be as follows:

Small engine..... $7.6 \times 45 = 342$ pounds.
Large engine..... $9.5 \times 35 = 333$ pounds.
Compound engine..... $10.1 \times 33 = 333$ pounds.

It is evident that so far as the coal consumed is concerned, the three methods are practically equal. The best method will therefore be the one which gives the least wear and tear, or the least trouble to apply, the first cost being too small in both cases to make interest a sensible factor.

This makes the most economical method that which derives the required power with the large engine alone, as the load upon it is only about half its working capacity, and, consequently, the wear and tear is very light; and, as a matter of fact, the engine has done the work for years with far less attendance and repairs than would be required if the small engine was made to perform the required work.

It is worthy of note that the greater proportional power required to overcome the friction of the automatic engine is due to the fact that its main shaft and flyweel, which cause the greater part of the friction, weigh much more in proportion to the total mean pressure on its piston than is the case with the small engine.

Electric Light at the British Museum.

In the galleries on the ground floor there are 69 arc lamps of various powers, while on the upper floors there are 57 arc and 627 glow lamps. In addition to these there are 5 large arc lamps in the reading room, 6 in the courtyard, and upwards of 200 glow lamps in the offices and passages. The total current required to work the whole of the lamps is nearly 1,200 amperes, with an E.M.F. of 115 volts at the lamp terminals; and this output is produced by the expenditure of nearly 200-brake horse power. The current is generated by four Siemens dynamo machines, each capable of giving an output of 450 amperes and 130 volts, which are connected to a general switchboard in the engine room by means of which they can be put to work in parallel to any or all of the circuits.

The switchboard is fitted with instruments indicating the current given off by each dynamo, and four circuits are led from it round the Museum—two for the upper and two for the lower floor. The main wires are laid outside of the building.

In order to insure safety, and to guard as far as possible against failure of light, the motive power is in duplicate. The four dynamos are driven in pairs, each pair by a separate engine with a separate countershaft. Each engine has a separate steam pipe in direct communication with the boilers, and there is an ample reserve of boiler power.

The power of the engines and dynamos is so adjusted that each of the two sets is capable of working the whole of the lamps in those galleries proposed to be lighted on any one evening; the other set standing by ready to work. Further, in order to work, if required, at half-power, or in order to provide half-light for the whole of the galleries—which light should suffice for an emergency, such as sudden fog or accident—the lamps are connected in pairs alternately, so that half of the number being cut off, the light of the other half still remains evenly distributed.

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MONDAY, FEBRUARY 17, 1890.

Gas Stocks.

Quotations by Geo. W. Close, Broke and Dealer in Gas Stocks,
16 WALL ST., NEW YORK CITY.
FEBRUARY 17.

☞ All communications will receive particular attention.
☞ The following quotations are based on the par value of $100 per share.

	Capital.	Par.	Bid	Asked
Consolidated	$35,430,000	100	96½	—
Central	500,000	50	—	—
" Scrip	220,000	—	—	—
Equitable	4,000,000	100	119	122
" Bonds	1,000,000	—	113	115
Harlem, Bonds	170,000	—	—	—
Metropolitan, Bonds	658,000	—	116	118
Mutual	3,500,000	100	107½	—
" Bonds	1,500,000	—	100	102
Municipal, Bonds	750,000		—	—
Northern		50	—	—
" Bonds	150,000	—	—	100
Standard Gas Co—				
Common Stock	5,000,000	100	42	46
Preferred	5,000,000	100	83	86
Yonkers		50	112	—
Richmond Co., S. I.	346,000	50	—	—
" Bonds	20,000	—	—	—
Gas Co's of Brooklyn.				
Brooklyn	2,000,000	25	109	111
Citizens	1,200,000	20	68	70
" S. F. Bonds	320,000	1000	100	103
Fulton Municipal	3,000,000	100	121	124
" Bonds	300,000		100	1 5
Peoples	1,000,000	10	77	—
" Bonds (5's)	368,000	—	100	—
" " (6's)	94,000	—	100	—
Metropolitan	1,000,000	100	93	96
Nassau	1,000,000	25	115	—
" Ctfs	700,000	1000	120	122
Williamsburgh	1,000,000	50	119	122
" Bonds	1,000,000	—	108	112
Out of Town Gas Companies.				
Boston United Gas Co.—				
1st Series S.F. Trust	7,000,000	1000	—	92½
2d " " "	3,000,000	1000	71	72
Bay State Gas Co.—				
Stock	5,000,000	50	24	25
Income Bonds	2,000,000	1000	—	--
Buffalo Mutual, N. Y.	750,000	100	90	95
" Bonds	200,000	1000	95	100
Citizens, Newark	1,000,000	50	155	160
" " Bonds.	45,000	—	--	—
Chicago Gas Trust	25,000,000	100	46½	—
Chicago Gas Light. & Coke Co.—				
G't'd Gold Bonds	7,650,000	1000	94½	94¾
Equitable Gas & Fuel Co., Chicago, Bonds	2,000,000	1000	97	—
People's Gas and Coke Co., Chicago—				
1st Mortgage	2,100,000	1000	—	99
2d "	2,500,000	1000	96	100
Consumers Gas Light Co., Jersey City	2,000,000	100	15	25
Bonds	600,000	1000	80	--
Cincinnati G. & C. Co.	6,000,000	100	201	203
Consumers Toronto	1,000,000	50	190	200
Central, S. F., Cal.			80	90
Capital, Sacramento, Cal			58	
Consolidated, Balt.	11,000,000	100	55¾	56
" Bonds	6,400,000		107	107½
Hartford, Conn	750,000	25	102	108
Jersey City	750,000	20	186	190
Laclede Gas Light Co., St. Louis, Mo.—				
Common Stock	7,500,000	100	16	18
Preferred "	2,500,000	100	—	—
Bonds	9,034,400	1000	85	86
Louisville, Ky	2,570,000	50	125	130
Little Falls, N. Y.	50,000	100	—	100
" Bonds	25,000	—	100	103
Montreal, Canada	2,000,000	100	200	208
Memphis (Tenn.) Gas	750,000	100	48	51
" Bonds.	240,000	100	103	—
New Haven, Conn		25	200	—
Oakland, Cal.			35	35½
Peoples, Jersey City		—	60	61
" " Bonds.			—	—
Paterson, N. J.		25	99	102
Rochester, N. Y.		50	99	100
Syracuse, N. Y.	500,000	25	—	—
San Francisco Gas Co.				
San Francisco, Cal.	10,000,000	100	55½	55¾
Washington, D. C.	2,000,000	20	200	208
Wilmington, Del.		50	88	90

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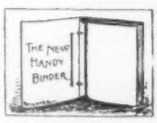

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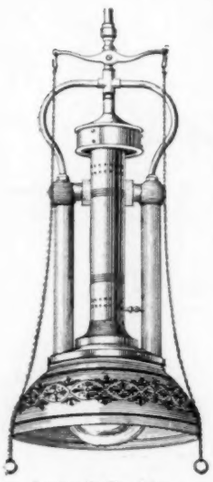

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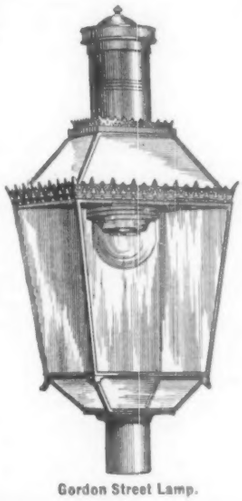

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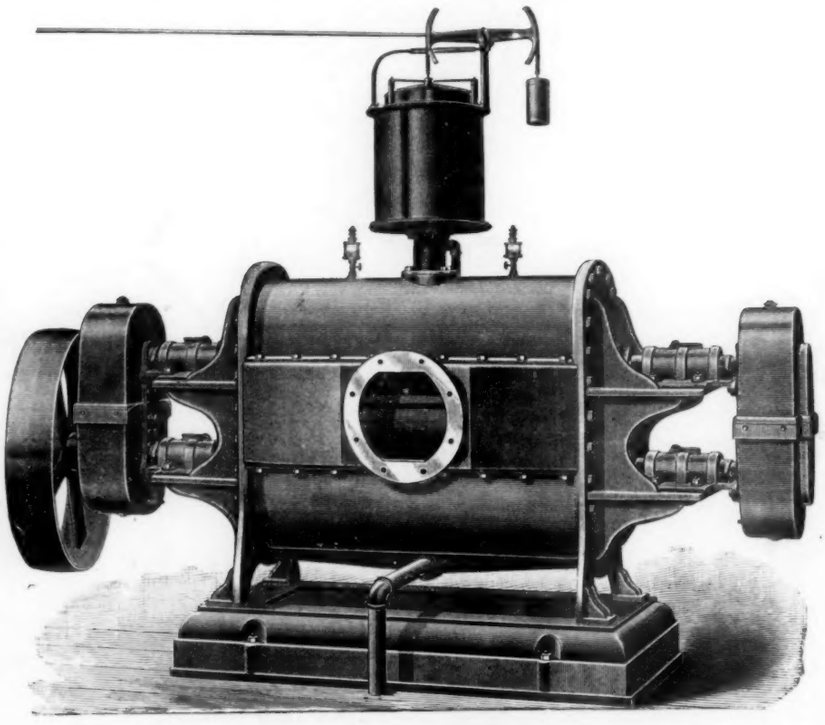

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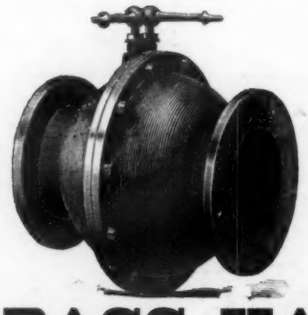

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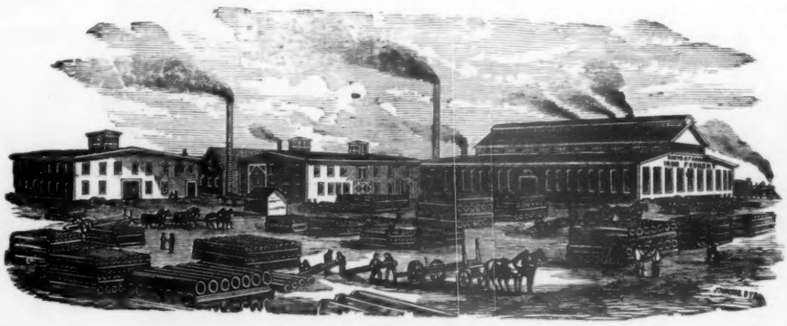

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No. 4,	"	"	500,000	"	"	"	6	"	"	"	"
No. 5,	"	"	750,000	"	"	"	7	"	"	"	"
No. 6,	"	"	1,000,000	"	"	"	8	"	"	"	"
No. 7,	"	"	1,250,000	"	"	"	9	"	"	"	"
No. 8,	"	"	1,500,000	"	"	"	10	"	"	"	"
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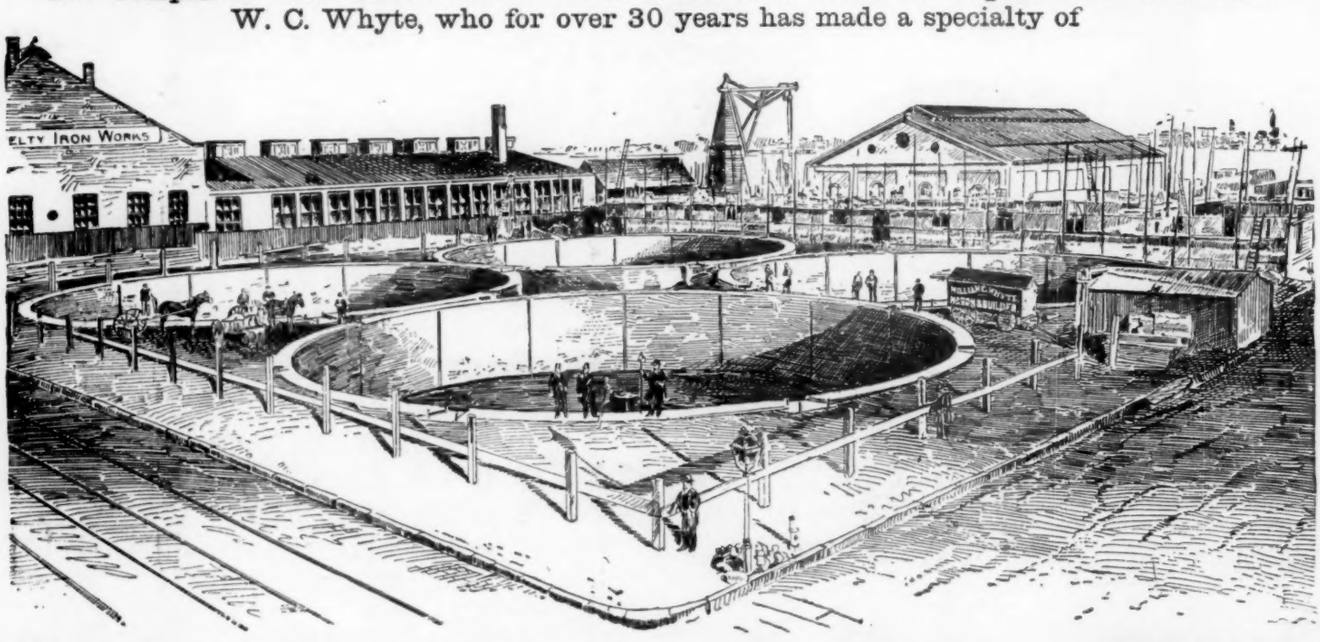

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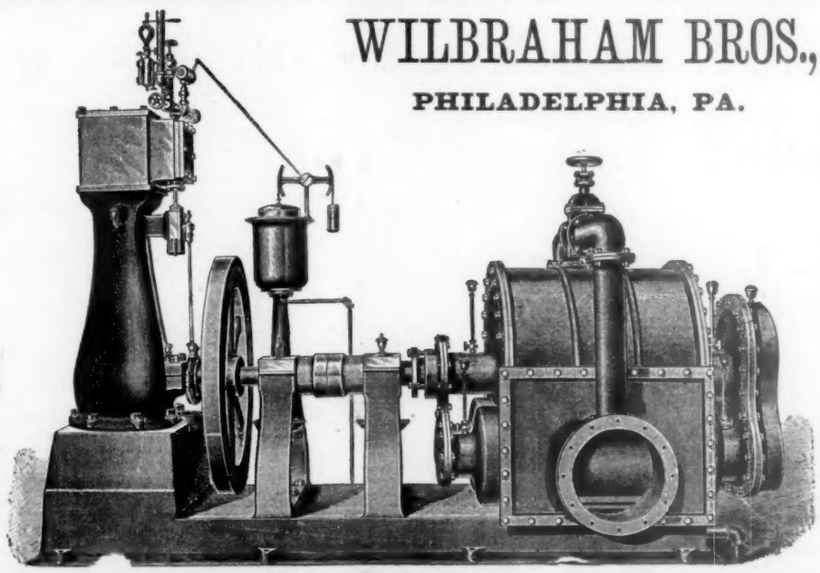

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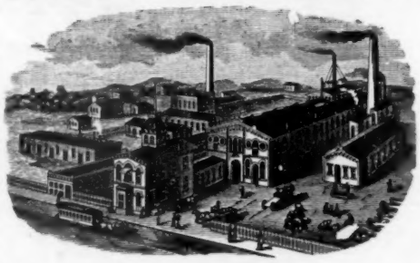

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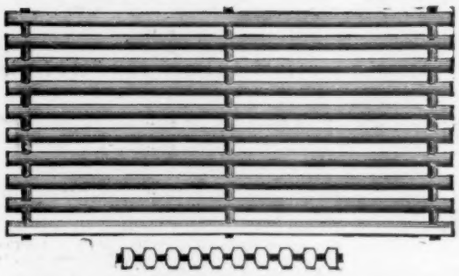

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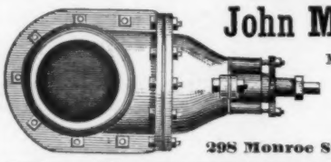

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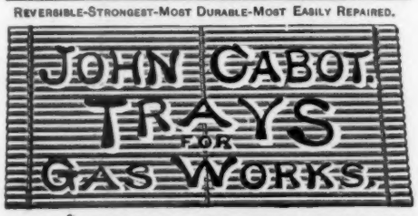

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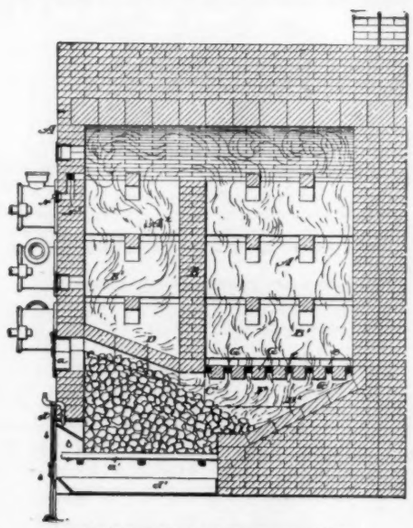

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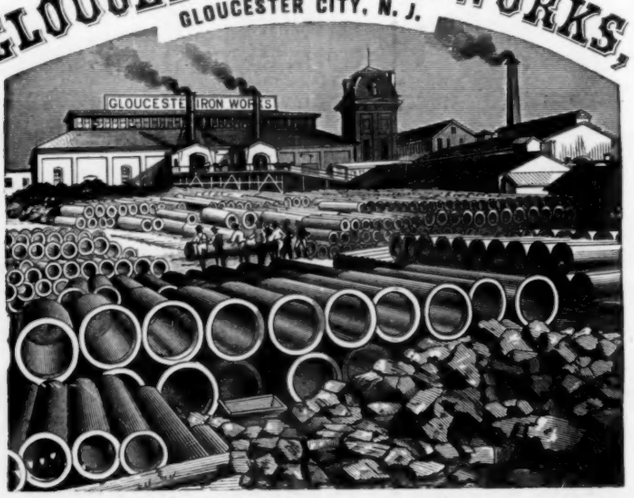

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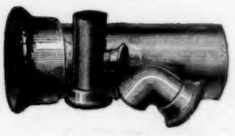

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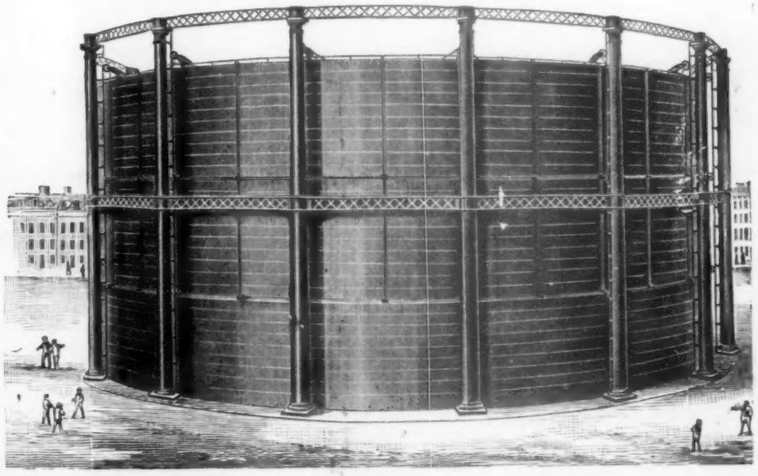

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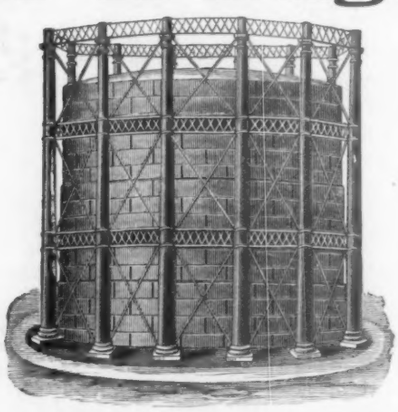

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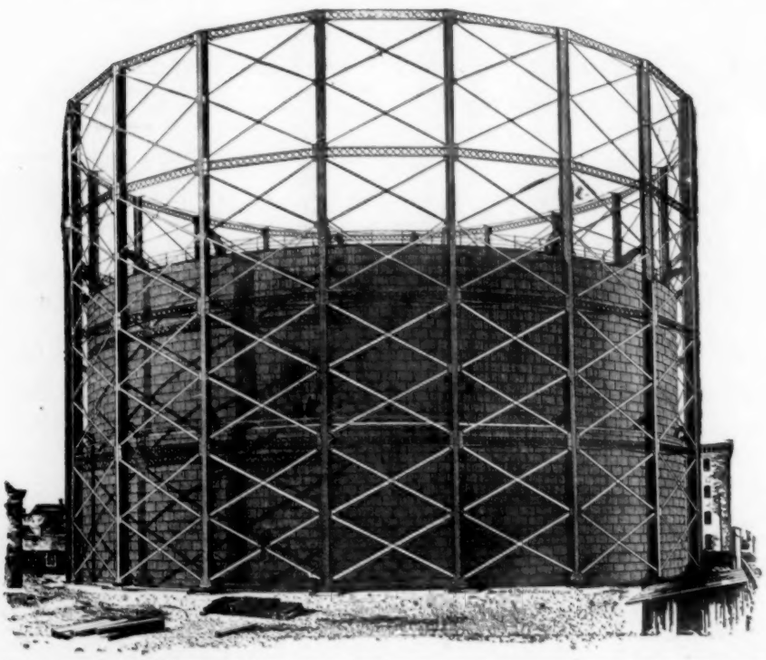

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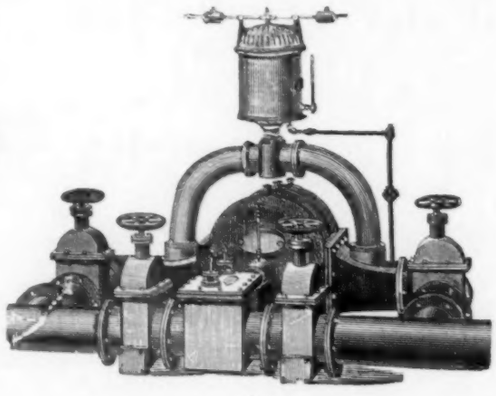

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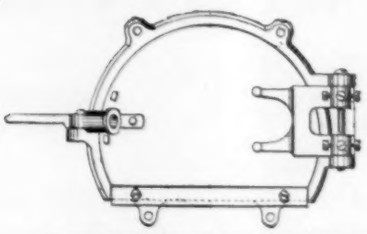

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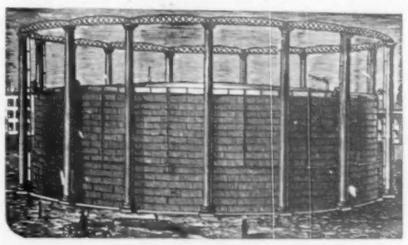
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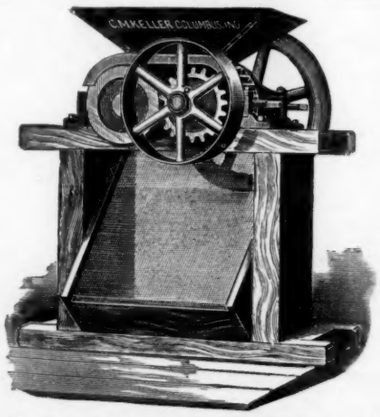

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GAS COOKING STOVE, No. 8 C.

SIZE.

Stove.	Oven.	Roaster.	Top.	Length over Extension Shelves.
37 in. high.	12 in. high.	12 in. high.	24 in. long.	36 in.
20 in. wide.	17½ in. wide.	18 in. wide.	21 in. wide.	
	12 in. deep.	13 in. deep.		

This Stove has four burners on top, and double oven burner.

Consumption of gas with all burners in use, 42 feet per hour, at 1 inch pressure.

The top is made in sections, so that a greater variety of cooking utensils may be used. By lifting out the covers and crosspieces and putting in a suitable forked ring, which is sent with each stove, a wash boiler or other large utensil may be set over two burners. Our **No. 87 GRIDDLE** also fits in the same position. The roasting oven is provided with a cast-iron door.

All Fittings are Nickel-Plated.

GAS COOKING STOVE, No. 7 B.

SIZE.

Stove.	Oven.	Roaster.	Top.	Length over Extension Shelves.
31 in. high.	9½ in. high.	10 in. high.	21 in. long.	32 in.
17 in. wide.	14½ in. wide.	15 in. wide.	16 in. wide.	
	12 in. deep.	13 in. deep.		

This Stove has three boiling burners in the Top or Hot Plate, and one single oven burner.

This cut represents our New Style Cooking Stove. As will be seen, it has an ornamented cast-iron Base and Front, and extension shelves. The Oven Burner, which is atmospheric (unless otherwise ordered), is of an entirely new and improved pattern (patent). The ovens are of greater capacity than those of the old style. The Top, in conjunction with the Outlet Pipe, is designed to carry off all the products of combustion, if desired, but they are also supplied with a loose ring which converts it into an ordinary open top stove.

The consumption of this Stove is 35 cubic feet per hour at 1 inch pressure, with all Burners in use.

All Fittings are Nickel-Plated

"RADIANT" BOILING STOVE, WITH REGENERATIVE BURNER.

Size, 6¾ inches diameter, 4 inches high. Consumption, 6 feet per hour at 1 in. pressure.

HOT PLATE, No. 111.

Size, 36 in. long, 12 in. wide, with three double burners, 6 taps.

Consumption, with all burners in use, 36 cubic feet per hour, with 1 in. pressure.

¾ in. supply pipe should be used where the pressure is 1 in. or over.